NON-INDEPENDENT MATE CHOICE IN HUMANS: DECIPHERING AND UTILIZING INFORMATION IN A SOCIAL ENVIRONMENT

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April 28th, 2010

Dedicated to the original Dr. Place, my dear mother, whose shoes somehow continue to grow through all these years.

Acknowledgements

Saturday, October 11th, 2003 – Parents Weekend at Colby College. Gathered around a small table at a restaurant in the backwoods of Maine, my mother, father, and undergraduate advisor spent what was supposed to be a relaxing evening grilling me on my future, while my poor fifteen year old sister sat and listened. It was this night, while the peaceful melodies from a harp played by an octogenarian filled the otherwise tense air, that I decided I wanted to go to graduate school, and pursue a doctorate in psychology.

In the six and a half years since that evening, there are a plethora of people who have helped and guided me on my way to where I am today: submitting my dissertation for a double PhD in Psychology and Cognitive Science. My love of research and commitment to academics (as compared to my previous life commitment to skiing) is due to the dedication, motivation and friendship of Dr. Clare Bates Congdon, my undergraduate advisor. I cannot thank Clare enough for introducing me not only to machine learning and the joy of discovery in research, but also for countless hours of one-one-one mentoring, and allowing me to cross into psychology when she knew my heart was not in computer science.

Following my time at Colby, my path to graduate school was invaluably shaped by my time in the Visual Attention Lab at Harvard Medical School under the tutelage of Dr. Jeremy Wolfe and Dr. Todd Horowitz. The two years spent studying psychophysics gave me the hard-nosed methodological rigor to excel at behavioral psychology. Their

acceptance of a bright eyed recent graduate into the academic family as a peer was a blessing in the knowledge, experience, and sense of community they imparted. And I will never forget the day a post-doc in the lab, Dr. Evan Palmer, mentioned to me there was a school in Indiana (Indiana!!) that sounded like a perfect fit for my interests.

At Indiana University, my development from a budding young graduate student into a confident and published researcher is the product of wonderful advising from the brilliant and kind Dr. Peter Todd. Peter has given me the space to grow, the guidance to prosper, and the resources to excel. From funding a summer at a research school in Germany out of his own start up funds, to challenging me to start my second year research project in the spring of my first year, Peter knew just when to push and when to support. His willingness to let me follow my own path, from pursuing non-traditional academic goals, to graduating early, are a testament to his true desire to see me succeed, not only as a graduate student, but with my own goals and dreams.

My four years at Indiana would not have been so productive, enjoyable and eye opening without the fantastic support of the Psychology Department and Cognitive Science Program at large. My fellow graduate students and professors have asked difficult questions and helped me solve intricate research problems. I would particularly like to thank Colin Allen, Randy Beer, Rob Bowers, Drew Hendrickson, Winter Mason, and Shiri Noy. Furthermore, my academic big brother across the ocean, Lars Penke, has been an invaluable resource both with his expertise and collaboration.

My path at Indiana has been shaped not only by Peter Todd, but also by the rest of my academic committee. I owe Dr. Meredith West the greatest thanks, for first

mentioning the idea of mate copying to me in the fall of my first year. Dr. Rob Goldstone, who first recruited me to Indiana, has been an invaluable resource in lab meetings providing insightful feedback as my research progressed. Dr. Eliot Smith has helped me find parallels from mate choice to other social interactions, and welcomed me into the social psychology community at Indiana. Finally, Dr. Stan Wasserman, the newest member of my committee has given his valuable time late in the game to enlighten and guide me into the world of social networks, where I hope to pursue further research after graduation.

This entire story wouldn't be possible without the undying support of my family, and in particular my Mom and Dad. Being the child of a psychologist mother might have some stereotypical drawbacks, but it also taught me to question everything, and to seek answers to explain the intricacies of human behavior and thought. My father, while not a scientist by training, instilled in me an even more important life lesson: To hold yourself to the highest standard, and that competition against your own goals is far more important than comparing yourself to others. The calm and collected unadulterated self-confidence that he displays, and that I strive to mimic, I believe is a product of this attitude. Mom and Dad have supported me (and guided me) since Day 1, and my accomplishments here are truly a testament to their commitment to education, science and the individual happiness of their children. I cannot thank them enough.

Finally, my graduate career has been funded through an Assistant Instructor fellowship from the Department of Psychological and Brain Sciences, summer support from the Cognitive Science Program and the Center for the Integrated Study of Animal

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NON-INDEPENDENT MATE CHOICE IN HUMANS: DECIPHERING AND UTILIZING INFORMATION IN A SOCIAL ENVIRONMENT

In mate choice, one must gather information to be able to ascertain the value of potential mates. This information can come from directly and independently gathered sources, by talking to each potential mate oneself, or through non-independent sources by monitoring the selections of others in one's local environment. In order for humans to be able to perform the latter, they need an adaptive mate choice mechanism that is able to accurately judge the romantic interest between others in their social environment. This ability to decipher romantic interest is uncovered in a series of studies using ecologically and externally valid stimuli of real mate choice interactions coming from speed-dating sessions. These studies demonstrate not only the presence of this ability in humans, but also the specific informative cues used when making these judgments. Furthermore, additional behavioral experimentation illustrates how humans could utilize this ability to inform their own mate choice decisions. By recognizing romantic interest between others, individuals are able to copy the selections of others, in a process known as mate-choice copying. This phenomenon is first described using a novel methodology, and then its nuances are uncovered regarding how age, attractiveness, other individual differences, and the strength of available information all affect who, when, and how an individual decides to copy the mate choice selections of others. Furthermore the role of differing definitions of popularity in network structures is uncovered. This body of work describes

how humans, in ways similar to many other animals living in social groups, utilize information coming from their social environment to adaptively guide their individual mate choice decisions.

Table of Contents

List of Figures

Introduction

Few decisions in one's life are more important than our choice in a life partner. This selection influences all walks of life – from our social lifestyle to our family to our daily routines. From a biological perspective, our choice in a partner is important because it influences the genetic makeup of our potential offspring (Andersson & Iwasa, 1996). While our own DNA is fixed, who we choose to mate with is the single largest contributor that we have any control over of the genetic makeup of our children. From our genes' perspective, mate choice becomes the only place we have any say in the structure of future generations (Kaplan & Gangestad, 2005). To this end, mate choice and mate selection becomes a vital adaptive skill, across many species, to find, court, and select a high quality mate (Ryan, Akre, & Kirkpatrick, 2007).

As high quality mates receive greater (and better) chances for mating, mate preferences can have a dramatic effect on the evolution of a species (Andersson, 1994). In humans, our mate preferences have been shaped by sex differences in the courtship process (Trivers, 1972). Men, with a concern mostly for a mate who can be healthy and strong enough to survive a pregnancy and raise a child, look for signs of fertility through attractiveness, symmetry and youth. Women, who look for a provider who will care for them and their offspring, need a mate who is physically strong and able to defend the new family, as well as high enough social status to provide food, shelter and financial support. While these descriptions might sound passé in today's society, they define the prehistoric landscape that has shaped the evolution of our species, and represent the strategies and preferences that are ingrained in our DNA (Buss, 2006; Buss & Schmitt, 1993). These

sexually selected attributes are passed down through the generations, and form the backbone of our mate choice processes.

However, these independent evaluations of quality and suitors made by men and women are not the only factors that decide our mate choice fate. For species living in social groups, such as humans, there are non-independent factors at play (Pruett-Jones, 1992). Mate choice decisions are not made in a vacuum, and while one individual is searching for mates who meet his or her criteria, others are doing the same. There then becomes a multitude of ways in which the opinions and decisions of others can influence our own mate choices (Westneat, Walters, McCarthy, Hatch, & Hein, 2000). In a world with millions if not billions of mate choice options, we are typically limited to individuals within our own local environment. Even within this group, it can become nearly impossible to talk to and interact directly with every possible suitor. Seeing whom others are interacting with, and who they like and dislike, becomes a potentially valuable source of additional information (Danchin, Giraldeau, Valone, & Wagner, 2004; Whitfield, 2002). However, it is not as easy as just asking others what their preferences are. A same-sex friend can quickly become a same-sex competitor when the conversation turns to mutual suitors, as they have no personal gain by telling you whom the best mates are. Therefore conversation, and particularly gossip, has validity issues as the information can be misguided, misrepresented, or purposefully false (Smith & Collins, 2009). In order for information coming from the social environment to be useful, it must be an accurate representation of what is actually happening. To this end, individuals need a way of assessing others' preferences and interest displays directly. If an observer can tell by watching a courtship display if it is successful or failing, honest or deceptive, then they

can bypass the validity issues in asking others what has happened. An observational ability could be part of an adaptive mate choice mechanism for survival in a complex social environment. This ability could function not only between others, but also within our own interactions—knowing who is interested in us is at least as important as knowing who is interested in someone else. These perceptions of interest could shape our mate choice and preference in novel and unexpected ways, combining with and perhaps even overshadowing the sexually selected independent assessment of suitor attributes (Dugatkin & Godin, 1992).

This dissertation will therefore present a series of studies that try to uncover and understand these adaptive mate choice mechanisms. With humans existing in social groups, it would make sense that we have evolved to take advantage of the additional information present in our environment. In the first section, I present a set of experiments that explore the abilities of an individual to observe and accurately perceive romantic interest between others. Once the presence of this ability is confirmed, I look to see what specific cues are driving the accuracy of these perceptions. If interacting couples, for instance daters, are giving off specific signals that indicate honest interest versus deceptive interest, it would be important for observers to be able to disentangle these presentations. Furthermore, if the signals are nonverbal observers might be able to decode their meaning without familiarity with the language used in the interaction. If nonverbal cues are used similarly across a wide range of cultures, than observers from varying backgrounds might be able to predict the outcome accurately. The universality of this ability supports the hypothesis of an adaptive mechanism that would have evolved to

handle many different types of social environments, and be general enough and adaptive enough to operate cross-culturally.

Once the ability to observe and perceive the romantic interest between others has been carefully documented and understood, I can look to see how individuals are utilizing this information. Section two explores the phenomenon of mate choice copying, wherein an observer's perception of interest presented by a same-sex conspecific towards an opposite-sex potential mate leads to an increased romantic interest of that observer in the target mate. This popularity effect utilizes the social information in the environment to alter one's own mate choice preferences. Once the effect has been documented, I delve into the details, studying how cultural differences, age, and attractiveness affect who an observer will copy. Furthermore, I look at changes in information sources—will an observer copy a same-sex conspecific when they know very little about them as compared to when they know a lot about them? Additionally I look at different types of copying behavior, studying how individual observers may differ in whether they become interested in the exact person they saw others interested in, or in a person who shares traits with that original person. Perhaps some personality and mate choice goals lead to one type of behavior over another. The three chapters in this section represent a major increase in our understanding of non-independent mate choice in humans, and how individuals are influenced and affected by the decisions of their peers.

Finally, I take a step back and look at our perception of our own success and failures. The same mechanism that allows us to perceive interest among others might allow us to perceive if our own date is interested in us. Over time, these perceptions could lead to a sense of our own dating worth, or our own prestige or rank within our dating

environment. In a carefully controlled and small environment, it is possible to look at how these perceptions change rapidly, and if men and women differ in the accuracy and affect of their own beliefs of their success. In section three I use social network measures to analyze a set of mate choice interactions where individuals recorded both their actual interest in their partner, and their perception of their partner's interest towards them. By comparing these perceptions with the attributes of the individuals that are involved with mate choice, I can see if being an actual high quality male or female influences how we perceive ourselves, and the kinds of offers we actually receive from other individuals.

Throughout the entire dissertation, there are several themes that appear in the construction of the hypotheses and experimental designs. First and foremost is the desire to be ecologically and externally valid. Most behavioral experiments that deal with mate choice present photographs or experimenter-generated imagery to represent individuals. Instead, I chose to use videotapes of actual mate choice interactions as stimuli in my experiments. While these presentations limit the precise control over what is happening during each trial, they also allow the natural flow of conversation and flirtation to come forth. By not using staged interactions, or controlling the presentation of individual cues, I can get a much better sense as to what information individuals would be seeing outside of laboratory experiments, and how that information is then used. In order to meet this goal, I used videotapes of individuals on speed-dates, searching and finding actual mates. My data comes from the Berlin Speed-Dating Study, a carefully controlled set of speed-dating interactions run at Humboldt University in Germany (Asendorpf, Penke, & Back, in press). The over 4000 available interactions between 382 daters is a rich set of stimuli that truly make this research program unique.

A second theme throughout this dissertation is the presentation of true romantic interest. A byproduct of using staged interactions and experimenter-generated stimuli is that the couples presented did not actually choose each other. The validity of the experiments is compromised if participants do not believe that the couples are actually romantically inclined. Deception, or in most cases just labeling interactions as being successful or labeling couples as being in relationships, can lead to bizarre results if observers are unconvinced by the presentations. A benefit of using a dataset of real mate choice interactions is that I have access to actual mate choice offers. In all of our experiments, observers either perceive the interest on the dates themselves, or are presented with information that is accurate and based on the actual outcomes of the interactions. This adds a further aspect of realism and embodiment to our studies: our stimuli come from the real world, are presented in a manner that mimics what would be seen in a realistic setting, and represent the actual outcomes found in the social environment. These themes will hopefully allow the results to generalize more readily to the behaviors found outside of the laboratory, and allow us to be more confident that my results, conclusions, and hypotheses are accurate and valid.

Section 1

Observing the Romantic Interest of Others

In mate choice, one source of information about potential mates is the opinions and preferences of others in our social environment. Who others like or dislike can influence our own opinions (Jones, DeBruine, Little, Burriss, & Feinberg, 2007). However, to be able to utilize this information, humans must possess an ability to accurately perceive the romantic interest between others. While testing for the presence for this ability might seem like an obvious first step to mate choice researchers, it had never been done – perhaps due to the difficulty in observing actual romantic encounters. Previous work has observed and catalogued the cues present during mate choice (Grammer, 1990; Moore, 1985; Moore & Butler, 1989), but never asked observers to perceive them for themselves from naturalistic presentations (Moore, 2002). In chapter one I present observers with video tapes of naturalistic first encounter dates, through presentations of speed-dates. These German speed-daters are observed by American college students, putting an emphasis on the non-verbal aspects of dating, and not the content of the conversations. These observers are in high agreement about which daters are easy to read and which are hard to read.

In chapters two through four, I look at what cues are driving this observational ability. In chapter two I present the same speed-dating video tapes to observers from different cultures, to see if the daters preserve their same readability across cultures. By comparing the accuracy results from samples from China, America and Germany, I can see how language comprehension and familiarity with western dating practices affect the perception of romantic interest. The results show that observers from all cultures show highly correlated accuracy, such that the easy to read daters stay easy to read and the hard to read daters stay hard to read—evidence for the universality of this adaptive mate

choice mechanism. In chapter three I try to pinpoint which cues observers are paying attention to at any given moment, by recording their eye movements and fixations while watching the same videos of German speed-daters. Surprisingly, I find that all observers seem to be paying attention to the same cues—whether they are correct in their perceptions or incorrect. Furthermore men and women are attending to the same information, begging the question of whether sex differences do exist in the perception of romantic interest (Abbey, 1982; Farris, Treat, Viken, & McFall, 2008). The robustness of these findings lead us to ask if perhaps observers are utilizing cues that do not require directed attention, and can be perceived in the periphery without fixation. This leads us to chapter four, were I study the effect motion cues have on the perception of interest—a cue that does not require directed attention. Using blurry quantized videos that remove low-level detail on dater attractiveness and facial emotions, I find that with limited information about daters and a reliance mostly on motion cues, observers match the readability of the natural video presentations.

The results from section one present a clear argument for the existence of an ability to perceive romantic interest between others, and the reliance on motion information to make these judgments. Motion is a cue that can be perceived without any knowledge of language or culture, which is supported by my cross-cultural findings. Furthermore, the lack of different fixation strategies between high and low accuracy observers, and between high and low readable daters, implies that motion may in fact be the most important cue utilized during the perception of romantic interest. Section one supports many of the theoretical positions already in the field that could not be efficiently tested experimentally until the use of my novel stimuli set (Grammer, Honda, Juette, &

Schmitt, 1999; Grammer, Kruck, Juette, & Fink, 2000). The combination of naturalistic stimuli with rigorously controlled behavioral experimentation and psychophysics gives us a fresh look into the perceptions of initial romantic attraction.

All work in section one has been done in collaboration with Peter Todd, Lars Penke and Jens Asendorpf. In addition, Jinying Zhuang of East China Normal University is a co-author of chapter two. Chapter one has been published in Psychological Science: (Place, Todd, Penke, & Asendorpf, 2009) while chapters two through four are in preparation for submission.

Chapter 1

The ability to judge the romantic interest of others

Preface

Our journey begins with testing for the presence of an adaptive ability to accurately judge the romantic interest of others. While previous work has looked at the ability to judge specific facial emotions (Willis & Todorov, 2006), or the ability to judge friendship cues from sexual cues (Abbey & Melby, 1986; Farris, Viken, Treat, & McFall, 2006), the ability to judge interest in an actual and appropriate romantic context has never been tested. This capability is required to be able to utilize information in a social context. Utilizing the opinions of others is not possible without being able to differentiate cases of interest from cases of non-interest. Therefore I start with the basics: presenting cases of actual romantic encounters, and having observers judge for themselves if the daters are presenting actual interest or not.

Introduction

It is adaptively important for an individual to be able to evaluate the interest level of a potential mate. Choosing a mate is a key component of gene promotion, and it is one of the most central decisions concerning reproduction across species (Andersson, 1994). Accurately appraising interest minimizes wasted time and resources and allows for a greater chance of success in a competitive mating market (Wiegmann & Angeloni, 2007). In terms of evolutionary life history theory, it is thus fundamental for an efficient allocation of mating effort (Kaplan & Gangestad, 2005). Correctly perceiving interest is useful not only for choosing a mate but also for determining one's own mate value via

this feedback (Simão & Todd, 2002), which is important for future mating decisions (Penke, Todd, Lenton, & Fasolo, 2007; Penke & Denissen, 2008). This makes it beneficial for humans to be able to pick up on cues that allow them to excel at such appraisals. These cues could include information available through language content and tone of voice as well as non-verbal behaviors such as body language, social signaling, and eye contact (Ambady & Rosenthal, 1992; Penke & Asendorpf, 2008).

In addition to evaluating a potential mate's interest level in oneself, it is advantageous to be able to evaluate the mate-interest levels between others via observed interactions. This is important for building knowledge of the surrounding social network (Pentland, 2007) including the availability and desirability of future potential mates (Simão & Todd, 2002; see also the mate copying literature for animals—e.g., Dugatkin, 1992; 2000, and humans, e.g., Jones, DeBruine, Little, Buriss & Feinberg, 2007). Observer perception in general has been a fruitful field for social psychologists: Kenny and colleagues (1994; 1987; 1996) studied "third-party metaperceptions" with subjects observing interactions between pairs of individuals, and found that people performed above chance at predicting who feels friendly toward whom. This and other social perceptions can be made accurately with limited information (see Ambady & Rosenthal, 1992, for a review).

Given the results on accurate observer predictions regarding friendship, along with the adaptive need for an efficient mechanism to predict interest in mate choice, I hypothesized that individuals will be able to accurately predict others' interest in oneself and others. Here I focus on the latter, third-party metaperceptions of how romantically interested others are in each other. To be adaptive in everyday situations, this ability

should require only a limited amount of information, suggesting that performance should not be hindered by shortened stimuli presentation times. Furthermore, because women face greater risks during mate choice due to their inevitably higher minimal parental investment in potentially resulting offspring (Trivers, 1972), I predicted that they would behave more cautiously, covertly, and ambiguously during initial interactions, making their intentions more difficult to read than those of men (Grammer, Kruck, Juette, & Fink, 2000; Haselton & Buss, 2000). Finally, I also investigated the observers' relationship status as a potentially confounding factor.

To test these ideas, I needed a set of mate choice-relevant interactions that observers could watch and judge, and for which I knew whether or not there was actual romantic interest so I could assess the observer's accuracy. Videos of speed-dating interactions fulfilled these requirements, and also allowed us to limit the information available to my judges by presenting them with clips of various durations.

Methods

Participants

The study included 54 participants, 28 women (mean age: 19.8, s.d. 3.8, 14 in relationships) and 26 men (mean age: 19.5, s.d. 1.1, 9 in relationships). Participants were recruited from the Indiana University psychology subject pool and were compensated with research credits required for undergraduate coursework. Participants were screened to be over 18 years old, heterosexual, and with no knowledge of the German language (because the stimuli were in German; see next section).

Stimuli

The videos of mate choice situations were gathered during a series of laboratory-based speed-dating sessions run at Humboldt University in Berlin, Germany. Speed dating is a paradigm designed to allow singles to meet a large number of possible mates in a short period of time (Finkel & Eastwick, 2008). The individuals who participated in the Berlin Speed Dating Study (BSDS) were recruited using advertising and publicity in media outlets; in exchange for free speed dating, they agreed to have their interactions videotaped and provide additional data. Seventeen sessions of speed dating were run as part of the study, for a total of 382 participants.

The "dates" took place in separated booths and lasted for three minutes, at the end of which each individual wrote down whether they were interested in seeing their date again (an "offer"). Pairs making mutual offers were given each other's contact information after the session so they could meet up again. The videos of these interactions were the stimuli used in my experiment. Audio (in German) and video of each of the two individuals in a speed-date, filmed with two separate over-the-shoulder cameras, were shown in a synchronized side-by-side combination to my participants. Videos of 24 interactions were used in this experiment, randomly selected from two different sessions comprising speed-daters in their 20s; each person appeared in only one video. This sample matched the entire population of interactions from the BSDS sessions with regard to offer rates from men (41%) and women (33%), as well as rates of mutual interest between individuals (15%).

Participants watched shortened video clips that were either 10 seconds or 30 seconds long, and came from the beginning, middle, or end of the date. For each of the 24 interactions I used, each participant saw four clips (in randomized order, both within and across interactions), 10-second clips from all three locations and one 30-second clip from a location that was randomized across interactions. The experiment design was therefore a mixed factorial design of 2 (observer sex: male, female) x 2 (relationship status: single, in relationship) x 3 (clip location: beginning, middle, end) x 2 (clip length: 10 sec, 30 sec).

Procedure

Participants first provided their age, sex, ethnicity, and relationship status. My dependent measure was the observing participant's perception of the interest within each speed-dating interaction they watched. Observers answered two questions after each video clip: "Do you think the man was interested in the woman?" and "Do you think the woman was interested in the man?" Their binary "yes" or "no" answers were then compared to the binary decisions of the actual speed-daters.

Results

The first question posed was whether observers could predict romantic/dating interest between others accurately. Figure 1-1 presents these results separately for prediction of male interest and of female interest, collapsing across all within-subject conditions. A paired sample t-test shows significant difference between the two

measures, $t(53)=3.64$, $p_{rep}=.986$, $d=1.00$. It is important to note that observers could achieve a chance accuracy above 50% in this task, if they accounted for the fact that daters made offers less than half the time (see above). Assuming that observers were aware of the actual offer prevalence rates, their chance levels would be 52% (= .41*.41 + .59*.59) for predicting male interest and 56% (= .33*.33 + .67*.67) for predicting female interest.

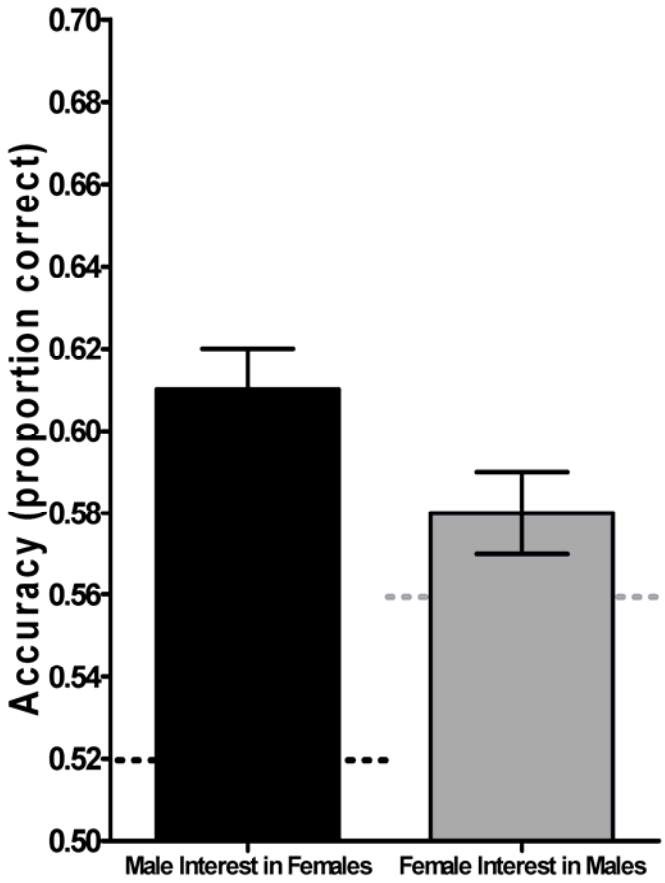


Figure 1-1: Overall accuracy. Dotted lines are chance performance levels for predicting interest for each sex dater. Error bars are +/- 1 S.E.M.

Observer performance on both of the dependent measures was significantly better than these adjusted chance levels ($t(53)=10.76$, $p_{rep}=.986$, $d=2.94$, for predicting male

interest, and $t(53)=2.24$, $p_{rep}=.908$, $d=.62$, for predicting female interest). Thus, observers do fairly well at predicting male interest and are just above chance at predicting female interest. (See Ambady & Rosenthal, 1992, for similar accuracy ranges for other thin-slice social perceptions.)

Each dependent measure was analyzed for contributing factors using a mixed-factor ANOVA. For predicting male interest in females, there was no effect of sex. There was an effect of relationship status, where individuals in relationships outperformed individuals who were single, $F(1,50)=6.18$, $p_{rep}=.935$, $\eta_p^2=.11$. The length of the video clip presented had no effect on accuracy. There was, however, an effect of video-clip location, $F(2,100)=16.86$, $p_{rep}=.986$, $\eta_p^2=.25$. None of the possible interactions reached significance. For predicting female interest in males, sex, relationship status, and video presentation length were all not significant. Mimicking the male-interest data, there was a significant effect of video location, $F(2,100)=16.18$, $p_{rep}=.986$, $\eta_p^2=.41$.

I further analyzed the within-subject factor of location using a single-factor ANOVA (with levels beginning, middle, and end), revealing a significant difference of location for predicting both male interest in females $F(2,106)=29.35$, $p_{rep}=.986$, $\eta_p^2=.36$ and female interest in males, $F(2,106)=36.52$, $p_{rep}=.986$, $\eta_p^2=.41$. Figure 1-2 shows the best performance at judging interest coming from the presentation of clips from the middle and end of the interaction. Post hoc comparisons using the Bonferroni correction showed significant differences between the beginning clip and both the middle and end clips for both male interest and female interest.

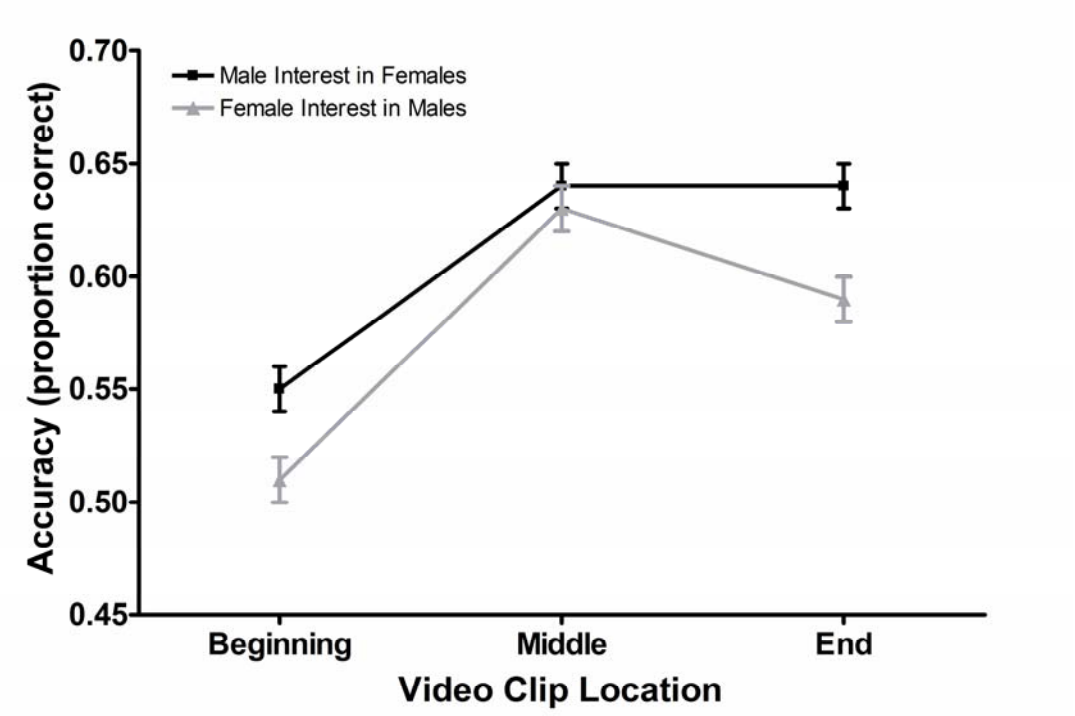


Figure 1-2: Accuracy by location. Error bars are +/- 1 S.E.M.

To look at how "readable" individual speed-daters were, the data were further analyzed at the per-dater level—see Figure 1-3. Daters were sorted from most accurately predicted (mean accuracy across all observers) to least. This was done by individual, not by interaction—in one video there could be a woman who is very easy to read (yielding high accuracy) with a difficult-to-read man (yielding low accuracy), and I assessed readability of these two individuals separately. In fact, being accurate at predicting the dating interest of one sex does not help in predicting the interest level of the other: the correlation between accuracy in predicting male interest and predicting female interest in the same video was zero, r=.00, p_{rep}=.083.

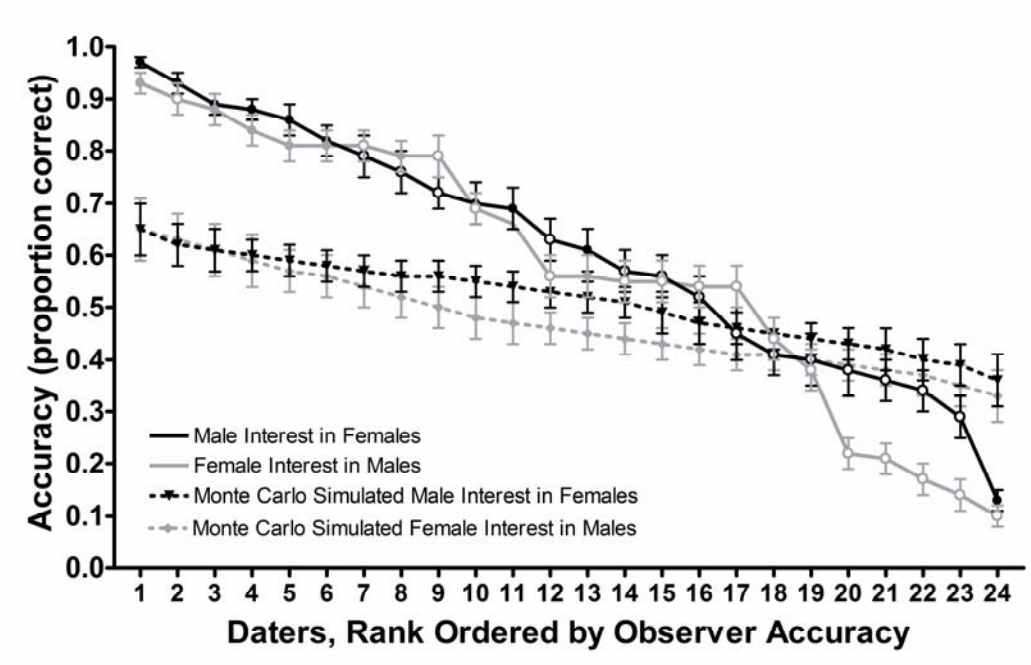


Figure 1-3: Accuracy for predicting each dater's interest, comparing human judges with Monte Carlo simulations. Error bars for observed data are +/- 1 S.E.M. Error bars for simulated expected data are 95% C.I. Open circles are when daters were not interest

The solid lines in Figure 1-3 show participants' mean accuracy at predicting all males and all females. The steep downward slope of both lines indicates the wide range in observers' ability to predict the interest level of different individuals. To find out if these results are different from those expected by chance, I ran a Monte Carlo simulation designed to determine chance-level performance based on guessing. The simulation generated a set of responses for each observer, for each video, for each of the 4 partial clips. Predictions of interest in each case were chosen randomly according to the interest-judgment rates (~60%) of observers. The simulation was run 1000 times, and the

responses were averaged within each observer for each dater in the videos, and then averaged across observers. The results rank-ordered across daters (Figure 1-3, dotted lines) have a slope that is less steep than the experimental data. Both the male and female human observer data fall clearly outside of the 95% confidence intervals of the Monte Carlo simulation in the top 10 daters who are easiest to predict. In addition, the 5 women daters who are the hardest for observers to read fall below the 95% confidence intervals, showing that observers are systematically fooled in these cases.

Discussion

The data supported my two main hypotheses: observers were able to assess the dating interest of others at above-chance levels, and the length of time required to do so was brief. For both sexes, accurately perceiving romantic interest both of and toward potential mates holds evolutionary benefits through the efficient allocation of mating effort. My results suggest that men and women possess this adaptive ability. Whether it is the result of a domain-specific adaptation or a more general ability for social perception remains to be determined. Furthermore, as predicted, it was on average much easier for observers to gauge men's intentions than women's (though there was high variance in observers' performance levels across individual daters of both sexes). The lower overall accuracy concerning women's intentions was not due to observers guessing or performing at chance, but to a systematic over-perception of interest on the part of the female daters (Figure 1-3)—surpassing 80% erroneous interest predictions for the five hardest-to-read women.

This dramatic rate of incorrect perception supports my hypothesis that women are harder to read, presumably because they mask their true intentions: As Grammer and colleagues (2000) argue, the biologically deep-rooted sex inequality in parental investment (Trivers, 1972) puts greater risks on the females of a species during mate choice. As a result, females, including women in speed-dating (Todd et al., 2007), are much more critical and picky when making mate choice decisions. Then, in order to evaluate potential mates longer without signaling their true intentions, women behave more covertly and ambiguously during initial interactions with the opposite sex. Men, in contrast, face lower risks and consequently should be less likely to hide their intentions. In my study, observers only see an individual interacting on one date, but perhaps if multiple dates with the same individual were presented, observers would be better able to differentiate instances of deceptive and true interest from that individual.

Whereas the degree of observer accuracy seems to depend heavily on the individual dater being watched, the length of time spent watching has almost no effect. However, a systematic difference in observer performance appears when comparing across video clip locations: the best observer judgment performance comes for video clips taken from the middle and end of the dates. This may arise because *daters* are using the information they gather throughout their few-minute encounter to make their ultimate decisions, so that their decisions are not fully determined, nor hence fully readable by others, until later in the encounter. If true, this would counter a major critique of speed-dating as a method of finding a long-term partner: that people are using only physical attractiveness to make their dating decisions because they do not have the time to assess much else (Eastwick & Finkel, 2008; Kurzban & Weeden, 2005; Todd et al., 2007).

Other data are needed to determine whether daters are using multiple cues over time, or just taking time to register an attractiveness-driven decision.

Some observers also appear to be better at using the available information for making some judgments. Whereas I did not aim to identify the individual differences underlying good observers (see Funder, 2001), I did find that observers who indicated they were currently in a relationship did better at predicting male interest than those currently single. This suggestive finding could stem in part from learning through relationship experiences. Alternatively, it is possible that the social skills necessary to succeed in finding and maintaining a relationship also support the ability to correctly perceive romantic interest. Studying younger observers before they have much relationship experience could help to disentangle these (and potentially other) hypotheses.

The results of this study add to the body of findings on the abilities of naïve observers to make quick and accurate judgments, demonstrating that this ability extends to assessments of romantic interest in the mate choice domain as well. I have shown this through a novel method that provides a strong criterion against which the observer judgments were evaluated: unambiguously stated, consequential mate choice decisions of actual partner-seeking singles meeting available potential mates while speed-dating. With limited information, observers can make accurate judgments of mate choice decisions, though their abilities may be hampered by the desire of some daters to mask their true intentions.

References

Abbey, A., & Melby, C. (1986). The Effects of Nonverbal Cues on Gender Differences in Perceptions of Sexual Intent. *Sex Roles, 15*(5), 283.

Ambady, N., & Rosenthal, R. (1992). Thin slices of expressive behavior as predictors of interpersonal consequences: A meta-analysis. *Psychological Bulletin, 111*(2), 256-274.

Andersson, M. B. (1994). *Sexual Selection*. Princeton: Princeton University Press.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Dugatkin, L. A. (2000). *The imitation factor : Evolution beyond the gene*. New York: Free Press.

Eastwick, P. W., & Finkel, E. J. (2008). Sex differences in mate preferences revisited: Do people know what they initially desire in a romantic partner? *Journal of Personality and Social Psychology, 94*(2), 245-264.

Farris, C., Viken, R., Treat, T., & McFall, R. (2006). Heterosocial Perceptual Organization: Application of the Choice Model to Sexual Coercion. *Psychological Science, 17*(10), 869-875.

Finkel, E. J., & Eastwick, P. W. (2008). Speed-dating. *Current Directions in Psychological Science, 17*(3), 193-197.

Funder, D. C. (2001). Accuracy in personality judgment: Some research and theory concerning an obvious question. In B. Roberts & R. Hogan (Eds.), *Personality psychology in the workplace* (pp. 121-140). Washington, DC: American Psychological Association.

Grammer, K., Kruck, K., Juette, A., & Fink, B. (2000). Non-verbal behavior as courtship signals: the role of control and choice in selecting partners. *Evolution and Human Behavior, 21*(6), 371-390.

Haselton, M. G., & Buss, D. M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology, 78*(1), 81-91.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. In D. M. Buss (Ed.), *The Handbook of Evolutionary Psychology* (pp. 68-95). New York: Wiley.

Kenny, D. A. (1994). *Interpersonal perception: A social relations analysis*. New York: Guilford Press.

Kenny, D. A., & Albright, L. (1987). Accuracy in interpersonal perception: A social relations analysis. *Psychological Bulletin, 102*(3), 390-402.

Kenny, D. A., Bond, C. F., Jr., Mohr, C. D., & Horn, E. M. (1996). Do we know how much people like one another? *Journal of Personality and Social Psychology, 71*(5), 928-936.

Kurzban, R., & Weeden, J. (2005). HurryDate: Mate preferences in action. *Evolution and Human Behavior, 26*(3), 227-244.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 113-1135.

Penke, L., & Denissen, J. J. A. (2008). Sex differences and lifestyle-dependent shifts in the attunement of self-esteem to self-perceived mate value: Hints to an adaptive mechanism? *Journal of Research in Personality, 42*, 1123-1129.

Penke, L., Todd, P. M., Lenton, A. P., & Fasolo, B. (2007). How self-assessments can guide human mating decisions. In *Mating intelligence: Sex, relationships, and the mind's reproductive system* (pp. 37-75). Mahwah, NJ: Lawrence Erlbaum.

Pentland, A. (2007). On the collective nature of human intelligence. *Adaptive Behavior, 15*(2), 189-198.

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive behavior, 10*(2), 113-136.

Todd, P. M., Penke, L., Fasolo, B., & Lenton, A. P. (2007). Different cognitive processes underlie human mate choices and mate preferences. *Proceedings of the National Academy of Sciences, 104*(38), 15011-15016.

Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Chicago, IL: Aldine-Atherton.

Willis, J., & Todorov, A. (2006). First Impressions: Making Up Your Mind After a 100-Ms Exposure to a Face. *Psychological Science, 17*(7), 592-598.

Wiegmann, D. D., & Angeloni, L. M. (2007). Mate choice and uncertainty in the decision process. *Journal of Theoretical Biology, 249*(4), 654-666.

Chapter 2

Judging romantic interest of others is a cross-cultural ability

Preface

In chapter one I showed that observers can in fact perceive the romantic interest between others. For a sample of American college students, there was high agreement in which daters were easy to read and which were hard to read. This is particular interesting given the fact that the daters were German nationals speaking in German, and my American sample were screened to have no knowledge of German. Here I test the effect of language comprehension and cultural familiarity on the ability to judge romantic interest between others. Two additional samples are gathered and compared to the original sample from chapter one: A Chinese college sample and a German population sample. If the cues used to recognize romantic interest are universal then the German and Chinese samples should perform equally to the Americans. If being able to understand the vocal content of the dates is helpful, then the Germans should outperform the others, and if cultural similarities prove beneficial, the Chinese should lag behind. In support of my adaptive mate choice mechanism hypothesis, I find cross-cultural similarity in romantic interest ratings not only at the global accuracy level between the three samples, but also for the readability of each individual dater.

Introduction

The ability to judge romantic interest between others is an important adaptive skill, as it allows us to learn about the structure of our social environment (Pentland, 2007) and the availability and desirability of potential future mates (Simão & Todd,

2002). I have previously shown that American college students posses this ability (Place, Todd, Penke, & Asendorpf, 2009), by having them watch video clips of German speed-daters and predict the outcome of those dating interactions. But are there cultural differences in this ability? Would Germans judge dating behavior in their own culture more accurately than Americans, or Chinese? There is considerable variety in courtship patterns and relationship styles across different cultures (Broude, 1983; Schmitt et al., 2004), and even in non-verbal flirtatious body motions of eastern and western daters (Grammer, Honda, Juette, & Schmitt, 1999). While individuals should be good at judging romantic interest *within* their own culture, this ability might not generalize to judging people from *other* cultures (Henrich, Heine, & Norenzayan, in press). On the other hand, low-level components necessary for making these judgments have been shown to function cross-culturally, with previous studies among more developed countries showing similarities in perceiving facial emotions (Ekman et al., 1987), judging personality in zero-acquaintance situations (Albright et al., 1997), and ranking mate choice preferences (Buss, 1989). A universal ability to decipher romantic interest between others would be evidence for an evolved adaptive mechanism useful for mate choice that might be resilient to cultural differences. To provide evidence for the presence of such an ability, I had participants from two additional populations, Germany and China, watch and make predictions about my German speed-dates. These cross-cultural comparisons allow us to test the effect on romantic interest judgments of familiarity with German/Western dating practices and language comprehension. I predict that people across cultures use a common mechanism to perceive romantic interactions from other

cultures in similar ways, ending up with roughly equal success in deciphering cues of romantic interest.

Methods

I studied three independent samples: 54 non-German-speaking US college students (mean age=19.7, 28 women); 70 non-German-speaking Chinese college students (mean age=19.9, 35 women); and a German general population sample of 69 participants (mean age=25.9, 39 women).

The stimuli in this experiment were identical to those used in my previous work (Place, et al., 2009). Video clips from 24 speed-dates between German singles in Berlin, who participated to find romantic partners, were presented to participants with audio; clips were of different lengths (10 and 30 sec) and from different portions of the original 3-minute dates (beginning, middle, and end). Observers answered two yes/no questions after each clip regarding the man's and the woman's interest in each other.

Results

The average performance in the task was in the range of 56% to 61% correct judgments. To compare average accuracies across the samples the raw accuracy data[1] was converted to z-scores to take into account the differences in base rate male/female interest (for more details see Place, et al., 2009). Accuracy for predicting male interest showed no significant differences across the three samples, with z-scores of 1.49 (SEM=.12) for the Chinese, 1.10 (.14) for the US, and 1.29 (.12) for the German sample. For predicting female interest the z-scores were .01 (.12), .33 (.14), and .50 (.12) for the Chinese, US, and German samples respectively; an ANOVA with post-hoc Tukey tests showed a significant difference only between the Chinese and German sample, $F(2,190)=4.25$, $p<.016$, $\eta_p^2=.04$.

For predicting male interest, observers in relationships outperformed (in proportion correct) those who were single, $F(1,181)=5.68$, $p<.018$, $\eta_p^2=.03$, sex of observer had no effect, and clips from later sections of the date were perceived more accurately than those from earlier parts of the date $F(2,362)=33.06$, $p<.000$, $\eta_p^2=.15$, mirroring Place et al. (2009). Clip length also mattered, $F(1,181)=6.15$, $p<.014$, $\eta_p^2=.03$, with Germans showing the greatest increase in performance for 30 second clips vs. 10 second. Culture interacted with clip location, $F(4,362)=4.502$, $p<.001$, $\eta_p^2=.05$ with all

[1] Raw accuracy was computed by comparing judgments of observers to the speed-daters' sequential selections made immediately following each date. This is slightly different from Place et al. (2009), thus my values for the US sample have changed slightly.

cultures increasing in performance between beginning and middle clips and German and Chinese further increasing from middle to end.

For predicting female interest, all main effects were identical to those from Place, et al. (2009), with observer relationship status, observer sex, and clip length all having no significant effect, and clip location making a difference, $F(2,362)=50.142$, $p<.001$, $\eta_p^2=.22$. There were no significant interactions.

I evaluated whether daters who were easy to read for the original US sample were also the easiest to predict for the Chinese and Germans. These per-dater results were very highly correlated across cultures (all $p<.001$). For predicting male interest, the correlation between US and Chinese judgments was $r=.79$, US/German was .80, Chinese/German was .68, and for predicting female interest, .84, .83, and .68 respectively. These similarities were uniform across the distribution of dates—the easiest to read daters were as highly correlated across the samples as the hardest to read.

Discussion

These results demonstrate strong similarities across cultures in the ability to judge romantic interest between others. Observers showed similar overall prediction accuracy across cultures, and similar effects of clip length and location. Strong correlations across samples at the per-dater level showed that the individuals who were easy or difficult to read by one culture remain so for other cultures. For predicting female interest—more challenging than predicting males—there is a slight increase in performance in the expected cross-cultural direction: as more information becomes available (via familiar

western-style dating experience and language comprehension) performance increases (Germans outperforming Chinese – with Americans in the middle). Despite the possibility of combining different sets of cues to reach different judgments, various cultures still seem to end up reaching the same conclusions on romantic interest. These results support the idea that the adaptively important ability to accurately perceive romantic interest from thin slices of behavior is common across human cultures, despite cultural differences in the cues that may be displayed and recognized.

References

Albright, L., Malloy, T., Dong, Q., Kenny, D., Fang, X., Winquist, L., et al. (1997). Cross-cultural consensus in personality judgments. *Journal of Personality and Social Psychology, 72*, 558-569.

Broude, G. (1983). Male-female relationships in cross-cultural perspective: A study of sex and intimacy. *Cross-Cultural Research, 18*(2), 154.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*, 1-49.

Ekman, P., Friesen, W., O'Sullivan, M., Chan, A., Diacoyanni-Tarlatzis, I., Heider, K., et al. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *Journal of Personality and Social Psychology, 53*(4), 712-717.

Grammer, K., Honda, M., Juette, A., & Schmitt, A. (1999). Fuzziness of nonverbal courtship communication unblurred by motion energy detection. *Journal of Personality and Social Psychology, 77*(3), 487-508.

Henrich, J., Heine, S., & Norenzayan, A. (in press). The weirdest people in the world? *Behavioral and Brain Sciences*.

Pentland, A. (2007). On the collective nature of human intelligence. *Adaptive Behavior, 15*(2), 189-198. doi: 10.1177/1059712307078653

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Schmitt, D. P., Alcalay, L., Allensworth, M., Allik, J., Ault, L., Austers, I., et al. (2004). Patterns and Universals of Adult Romantic Attachment Across 62 Cultural Regions: Are Models of Self and of Other Pancultural Constructs? *Journal of Cross-Cultural Psychology, 35*(4), 367-402. doi: 10.1177/0022022104266105

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive Behavior, 10*(2), 113-136.

Chapter 3

Men and women attend to the same cues during judgments of romantic interest

Preface

In chapters one and two I present evidence for the presence of a universal ability to predict the romantic interest of others, by showing videos of Germans speed-dating to a variety of observers in samples from America, Germany and China. While it is clear that observers are able to make accurate assessments from brief video clips, it is unknown what information they are using to make these judgments. In order to get a better idea of which cues are driving this decision making process, in chapter three I present the same videos to a new sample of American college students, while tracking their eye movements and fixations. By knowing precisely where individuals are looking while watching these first encounter mate choice interactions I can get a broad idea of what cues the observers are attending to. Previous research has catalogued the list of cues that are presented during mate choice, which are plentiful and varied (Grammer, 1990; Moore, 1985). Surprisingly, I find that all observers seem to be attending to the same cues at the same time, regardless of the readability of each dater. While high accuracy observers attend to a slightly different pattern of features compared to low accuracy observers, it is clear that when it comes to directed attention, participants are all paying attention to the same information at the broad level of analysis I report. This implies that differences in accuracy come either from processing the same information differently, or from utilizing cues that do not require fixation to be perceived.

Introduction

When searching for a mate, one must gather information to ascertain the value and availability of potential partners (Simão & Todd, 2002). Along with sexually selected cues of health, strength, and beauty, this information includes who in the local environment is interested in you, and furthermore the romantic interest between others. Accurately appraising interest minimizes wasted time and resources and allows for a greater chance of success in a competitive mating market (Wiegmann & Angeloni, 2007). Recent research has shown that humans possess this ability and can predict the romantic interest between others from brief videos of speed-dates (Place, Todd, Penke, & Asendorpf, 2009). However, it is unknown what cues are attended to and utilized when making these judgments, and furthermore whether men and women use the same cues and decipher their meaning in the same way.

Decisions based on observing complex realistic stimuli with many potential cues, only some of which are informative, can be made quickly and with limited information, both within mate choice (Place, et al., 2009) and other social domains (Ambady & Rosenthal, 1992). Grammer and Moore have independently catalogued a variety of cues that are present during initial romantic courtship, some predictive of courtship success but the vast majority merely ancillary (Grammer, 1990; Moore, 1985; Moore & Butler, 1989). Grammer has further shown that nodding behavior by women has the potential to control the flow of male conversation by providing feedback on conversational content (Grammer, Kruck, Juette, & Fink, 2000), and that the information most predictive of romantic interest might be embodied in the global motion of the daters over time

(Grammer, Honda, Juette, & Schmitt, 1999). Other predictive cues could come from the physical attractiveness of the daters, as compared to the signals they are giving off. Both faces and bodies contain cues that are predictive of genetic quality and would be valuable for judging mate value (Thornhill & Grammer, 1999), and therefore could influence romantic interest as well.

However, the information coming from the man and the woman in the interaction might not be of equal validity. Because women face the greater cost of conception, evolutionary theory predicts that they could be coy and initially deceptive in their displays in order to have additional time to gather information about perspective mates before expressing actual interest (Grammer, et al., 2000; Trivers, 1972), and experimental evidence supports this idea (Grammer, et al., 1999; Place, et al., 2009). Therefore observers of these interactions attempting to determine romantic interest might not attend to the man and the woman they are watching in the same way. While women might be controlling the conversation through nodding behavior, and their rate of feedback indicative of the man's interest, they also could be simultaneously masking their own intentions and providing superfluous information that might be difficult to decipher and categorize into friendly flirtation or actual interest. Therefore attending to a woman in a dating interaction might be helpful or frustrating—it is unclear if focusing one's attention and effort on her is an advantageous strategy. Indeed the information a woman presents could be deciphered differently by men and women observing a dating interaction, as the same cue could hold different meaning to each sex.

Within mate choice, men and women have evolved different biological goals: men the need to find youthful healthy mates to carry their offspring and pass on their

genetic heritage, and women a strong provider who can protect and care for them and their offspring. These differences in evolved goals coupled with the differences in parental investment and costs of pregnancy mentioned earlier (Trivers, 1972) have led to sex differences in the use of sexually selected cues, behaviors, and mate choice strategies (Buss, 1989; Buss & Schmitt, 1993). In turn, these sex differences (combined with cultural and social gender norms) affect how men and women perceive and judge interactions and individual characteristics that pertain to mate choice. A variety of studies have found sex difference in appraisals of facial emotion (McClure, 2000; Thayer & Johnsen, 2000) and first impressions of personality characteristics (Carney, Colvin, & Hall, 2007) to gaze patterns when viewing clothed models (Hewig, Trippe, Hecht, Straube, & Miltner, 2008) or erotic pictures (Rupp & Wallen, 2007) — all components of recognizing and appraising romantic interest. Furthermore, when presented with friendly interactions, either as scripts, photographs, or video-taped natural conversations, men repeatedly misperceive the intentions of women as more sexual compared to female observers of the same stimuli (Abbey, 1982; Farris, Treat, Viken, & McFall, 2008b; Lindgren, Parkhill, George, & Hendershot, 2008). While competing hypotheses predict that this difference comes either from a man's bias for expecting a woman's interest, providing an evolutionary advantage to avoid missed sexual opportunities (Haselton & Buss, 2000), or from a sensitivity difference in the perceptual abilities of men and women to discern sexual versus non-sexual interest cues (Farris, Treat, Viken, & McFall, 2008a), it is clear that sex differences exist when making these judgments.

The aforementioned studies demonstrated that in the domain of mate choice, there are sex differences in how facial expressions, explicit images of female bodies, and

female friendly behavior are attended to and perceived. However this does not imply that there will be strong sex differences in the perceptions of actual mate choice decisions—it could be that men and women perceive the outcomes of mate-choice-relevant encounters in the same way. Place et al. (2009) found no differences between male and female observers of first-encounter speed-dating sessions, and this effect has been replicated cross-culturally (Place, Todd, Zhuang, Penke, & Asendorpf, submitted).

When perceiving romantic interest among individuals in one's social environment, it is evolutionarily advantageous to be accurate at perceiving the interest for *both* opposite and same sex individuals independent of your own sex. . Recognizing opposite-sex interest provides information on the availability of prospective partners and the kinds of mates they are attracted to. On the other side, same-sex perceptions have been shown to influence mate choice decisions in potentially adaptive ways through mimicry of peers' choices, a process known as mate choice copying (Dugatkin, 1992; Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Place, Todd, Penke, & Asendorpf, in press--see section two). Supporting this contention, both men and women have been shown to appraise opposite-sex interest as well as same-sex interest (Place, et al., 2009).

Therefore, while men and women have different mate choice strategies, and are interested in different qualities in mates, the benefits of being able to accurately perceive romantic interest of opposite-sex and same-sex individuals in one's social environment holds for both men and women. Consequently, I predict that an evolved adaptive mechanism for making these appraisals of the romantic interest between others is present (and operates similarly) in both men and women.

In the present study, I test this prediction through uncovering what information men and women use when making these judgments of romantic interest between others, by recording participants' directed attention through eye movements while they watch brief videos of first-date encounters. Previous studies using eye-tracking to monitor the cue-use of men and women have investigated only naturalistic gaze patterns—where individuals look when they are given no task to complete (Hewig, et al., 2008; Rupp & Wallen, 2007). This is very different from the goal oriented strategies employed during mate choice.

Two possibilities could emerge through this new eye-tracking study. First, men and women could exhibit different eye gaze patterns and attend to different cues, as would be expected based on the previous literature on naturalistic gaze patterns of men and women to stimuli with emotional or sexual content (Hewig, et al., 2008; Rupp & Wallen, 2007). Alternatively, because men and women are faced with the similar challenge of deciphering intentions of both potential suitors and potential competitors, they could have evolved similar attentional mechanisms that lead to similar patterns of looking for cues. While men and women may look at images of bodies and faces differently when they have no particular goal to fulfill as in previous studies (Hewig, et al., 2008; Rupp & Wallen, 2007), when they are faced in my experiment with the same naturalistic goal-directed task of judging romantic interest, their strategies could become very similar.

Methods

Participants

Observers comprised 26 women (mean age 19.1) and 27 men (mean age 19.9) recruited from the Indiana University psychology participant pool and compensated with course credit. All were over 18 years old, heterosexual, and with no knowledge of the German language (because the stimuli were in German; see next section).

Stimuli

The stimuli used in the experiment were videos of the individuals who participated in the Berlin Speed Dating Study (BSDS). These individuals participated in video-monitored experimental speed-dating sessions at Humboldt University in Berlin (Asendorpf, Penke, & Back, in press). Speed-dating is designed so that singles interested in finding a partner can meet many people in a short amount of time (Finkel, Eastwick, & Matthews, 2007). Participants in the BSDS were singles from the general population who were interested in finding a mate. They engaged in a series of three-minute interactions each with another person of the opposite sex, and at the end of each short date they rated their interest in seeing the other person again. Pairs who were mutually interested were given each other's contact information at the end of the session.

For this experiment, I chose 48 videos from the BSDS sessions, all of daters in their 20's. The videos were composed of synchronized footage from two camera angles that were displayed side by side to present a naturalistic view of the man and the woman on each speed date (for details, see methods of Place, et al., 2009). I used ten second clips from the middle of the videos as my stimuli because previous research has shown that

this section of the date provides highly useful information on the intentions of the daters (Place, et al., 2009). Participants watched these videos from a fixed seated position, such that the entire computer monitor encompassed 32.7 degrees of visual angle vertically and 40.9 degrees horizontally. Videos were centered on the screen horizontally and slightly above center vertically and covered 28.1 degrees of visual angle horizontally and 12.2 degrees vertically.

The videos were presented in three randomly-ordered blocks, and the order of the videos within each block was also randomized across all the trials (with each trial representing one video display and question prompt). Blocks differed in the task that the participant was asked to complete (see Procedures). Two blocks contained 12 videos each, and the third block contained 24 videos. These 24 videos in the third block were from the same dates used in Place et al. (2009), but comprised only a subset of the video lengths and locations used in that study. Videos in each block were also chosen so that the rates of interest reported by men and women in the speed-dating interactions shown matched the base rates of interest across all speed dating sessions: interest by the men 42% in of the interactions, and by the women in 33%, thus leading to mutual positive interest in 15 % of the interactions.

Procedure

Participants first reported their gender, age, self-attractiveness rating, current relationship status, number of romantic relationships that lasted at least three months, number of sexual partners in their lifetime, and filled out the revised Sociosexual Orientation Inventory (Penke & Asendorpf, 2008). Next, participants sat down, placed

their head in a chin rest to minimize head movements, and were calibrated to the eye tracker using a 9 point calibration. A white fixation cross appeared in the center of the screen for 1.5 seconds before the start of each video. While the participants watched each ten second video, the movements and fixations of their right eye were recorded by an EyeLink CL eye tracker from SR Research Ltd at 1000 Hz. I recorded the length, duration, and number of fixations during each video. Following each video, participants were asked to make a response about the romantic interest of particular individuals ("targets"). In one block of videos, participants were asked: "Do you think the man is interested in the woman?" The subjects responded by key press with the binary choice of "yes" or "no". In another block, participants were asked: "Do you think the woman is interested in the man?" In the third block (randomly ordered), with twice as many videos, participants were asked to answer the questions about both male and female interest. Participants were given a break after each block (the third block was broken up into two sections) and were recalibrated after each break.

Results

I first measured how accurate observers are at predicting the romantic interest between two individuals, by comparing the actual interest reported by the daters to the perceptions of interest by the observers. The pattern of results was similar to my previous work (Place, et al., 2009; Place, et al., submitted), with accuracies ranging from .40 to .65. Additionally, participants exhibited the same dramatic variance in accuracy of

judging the interest of different individual daters as I had seen previously (Place, et al., 2009), with some dater's intentions being accurately determined at near perfect levels (.96) and some befuddling nearly all participants (.04). Participants were in agreement over which daters were easy to read and which were difficult to read, with a between-participant reliability (Cronbach's Alpha) of .97. Across all the blocks there were no significant differences in average performance between male and female observers, with one exception: When asked about the interest of both the man and the woman on a date, female observers were significantly better at predicting the interest of the women with an average accuracy of .66 (.01) than male observers were, .61 (.01), $t(51)=-2.39$, $p<.021$, $d=-.67$. However, this result did not appear when observers were asked only about women, and has not appeared in any of my previous findings, so I will not interpret it further.

The next step in my analysis was to see how much time observers spent looking at each dater in the videos, and whether there were differences by sex or by block task in information gathering in terms of looking times. I divided the screen into two interest areas: a male region and a female region. The male region consisted of the video of the man on the date which always appeared on the left side of the screen, and the female region consisted of video of the woman on the date which always appeared on the right side of the screen. Any fixations outside of the videos were considered to be null and were not used in the analyses. Fixations in the null region represented on average less than one percent (60ms) of the total fixation time per trial (10 seconds). Saccades and blinks accounted for roughly 800 ms on average, and were also excluded. Figure 3-1

presents the mean total fixation time spent by observers in the male and female interest areas.

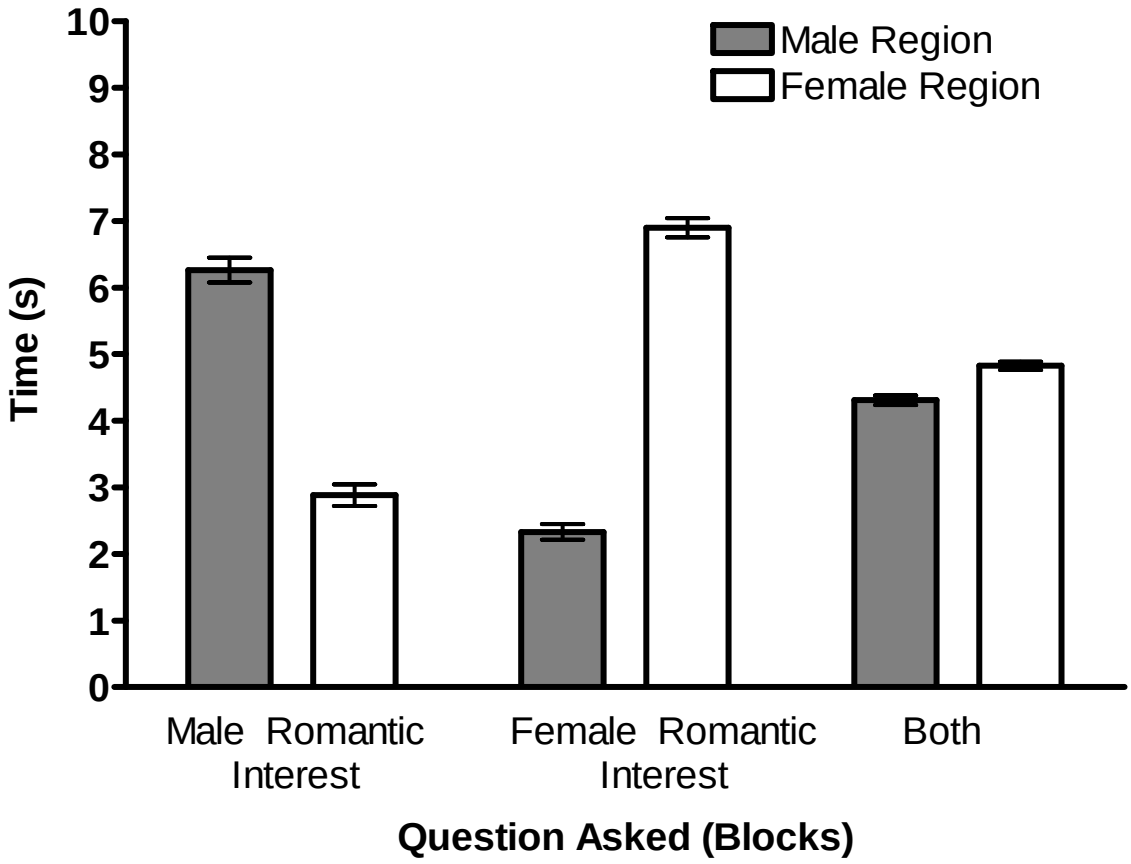


Figure 3-1: Mean total time spent by observers fixating in each interest area in each condition (out of 10 seconds per trial).

Observers who were asked about only the interest of one dater spent significantly more time looking at that person compared to their date, $t(52)=9.85$, $p<.001$, $d=2.65$ for predicting males' romantic interest and $t(52)=-17.69$, $p<.001$, $d=-4.70$ for predicting women. At the same time, observers spent *relatively* more time looking at the woman on

the date in a couple of ways: More time spent looking at a woman when asked about her intentions compared to time looking at a man when asked about his intentions, $t(52)=.09$, $p=.000$, $d=-.52$, and more time spent looking at a woman when asked about a man's intentions compared to time spent looking at a man when asked about his date's intentions, $t(52)=3.47$, $p<.001$, $d=.961$. Additionally, when asked about both individuals on the date, observers favored the woman with significantly more looking time, $t(52)=-4.21$, $p<.001$, $d=-1.03$. Thus overall women seem to garner relatively more attention.

The only difference in looking time in any of the three blocks between male and female observers was that when asked about only the man's interest, they attended to opposite-sex daters longer. Male observers looked longer at the woman when asked about the man's interest than did female observers, $t(51)=3.23$, $p<.002$, $d=.90$, and vice versa—female observers looked longer than male observers at men when also asked about the man's interest, $t(51)=-2.20$, $p<.033$, $d=-.62$.

The measure of total fixation time is a combination of two variables: the number of fixations and the length of each of those fixations. Deviations from the patterns found in overall looking time could exist in one or both of these components. The average number of fixations was calculated for each interest area for all three blocks, and the same patterns were observed as for total fixation time, with one exception—there was only one significant gender difference (instead of two), with men looking more often than women did at women when asked about the man's interest, $t(51)=2.15$, $p<.036$, $d=.60$. Additionally, for fixation length, the same pattern existed as for number of fixations, both in main effects, and in gender differences of the observers. Details on these analyses,

with mean values, significant difference testing and effect sizes can be found in the supplemental information.

Next, I analyzed whether observers were systemically attending to facial cues and body cues differently while making their decisions (Figure 3-2). Each male and female video region was further divided into two sub-regions. This division line was determined individually for each dater in each video, using the highest horizontal line between head and body that the head of the dater did not cross at any point during the video. The region above the line was deemed the head sub-region, and the area below the line the body sub-region. Note that this analysis does not separate fixations on the head of the individual from any other fixations occurring above the division line; however, a qualitative review of fixation locations showed the vast majority occurred on the head of the dater and not the surrounding background. Videos in which daters moved vertically in a way that would cause their heads to cross the horizontal line repeatedly were excluded from the analysis (for example rocking back and forth in their chair). This eliminated one video (out of 12) in the block where observers were asked about male interest, no videos from the female interest condition, and eight (out of 24) from the combined interest condition[1].

[1] Further analysis on individual facial regions (eyes vs. mouth) was not possible with this methodology, as the resolution of the eye tracker was 1° of visual angle, which coincided with the average total diameter of the dater's facial region, given the size of the display and the observer's distance from the monitor. Thus it was not possible to analyze fixations on individual facial attributes.

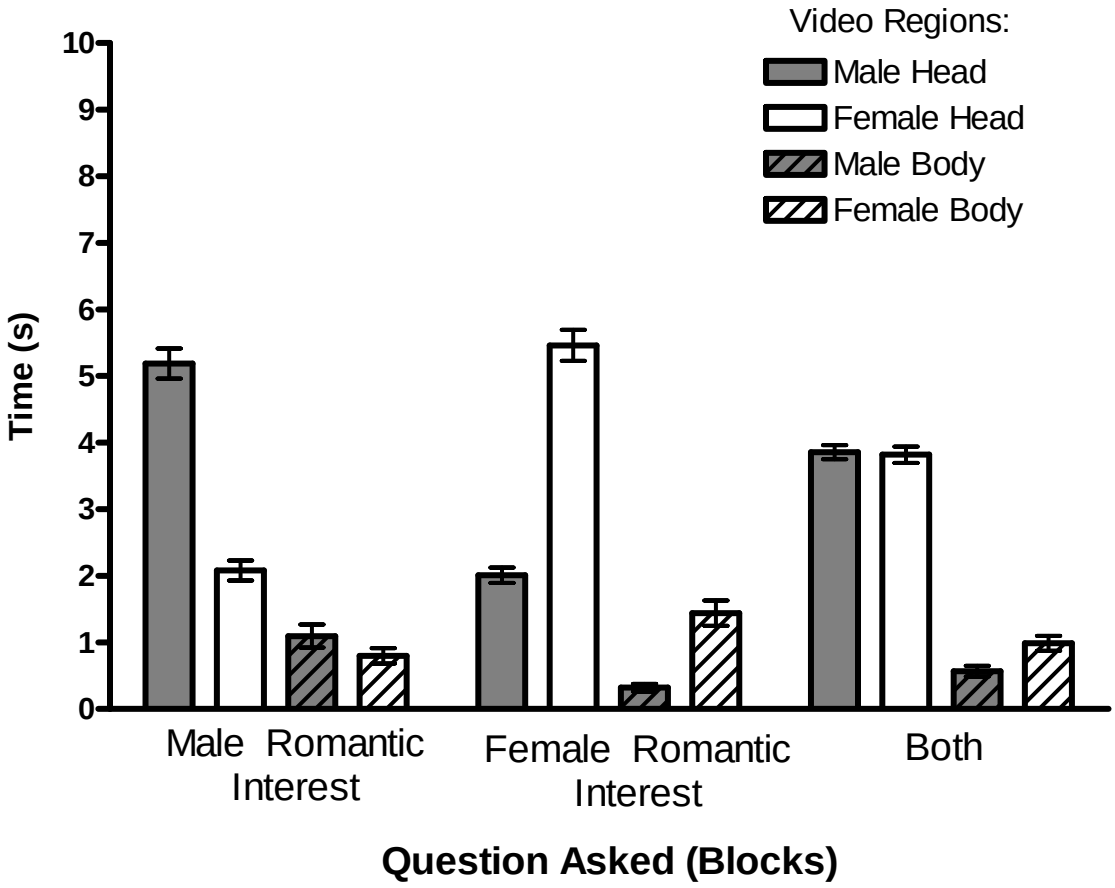


Figure 3-2: Mean total amount of time spent fixating on each individual's head or body in each trial (out of ten seconds).

When asked about male interest, observers spent significantly more time looking at the man's head than the woman's, $t(52)=11.28$, $p<.001$, $d=2.24$. Similarly, when observers were asked about female interest, they spent more time looking at the woman's head than the man's, $t(52)=-11.99$, $p<.001$, $d=-2.59$, but also spent more time looking at the woman's body than the man's, $t(52)=-6.32$, $p<.001$, $d=-1.10$. When asked about both male and female interest, there was no significant difference in the amount of time

observers spent looking at the man's or woman's head, however, observers spent more time looking at the woman's body than the man's, $t(52)=-5.56$, $p<.001$, $d=-.58$. Breaking down the previous results where women daters are attended to more than men, this further analysis of head versus body fixations shows that women's bodies are attended to for a greater amount of time than are men's bodies.

I also looked for differences in information gathering between high-accuracy observers (>1 SD above global mean) and low accuracy observers (>1 SD below mean). When asked about the woman's interest, high-accuracy observers paid more attention to the woman dater and in particular her body than did low-accuracy observers. This trend only appeared when observers were asked about female interest. High-accuracy observers had more fixations and spent longer overall looking at the woman's body, and had shorter fixations on and less time overall looking at the man's head, than low-accuracy observers. These results are all trending ($p<.08$) but not significant, due in part to the low number of observers in each group (N=8 for high accuracy, N=9 for low), and therefore should be considered preliminary.

Across all three blocks there were no significant sex differences in the amount of time male versus female observers spent looking at each of the four sub-region interest areas. This lack of sex differences in the results so far led us to examine in more detail whether male and female observers are attending to the same information over time. To do so, I recorded which of the four interest areas each participant was looking at each millisecond. I then summed these millisecond counts into 100 ms bins, separately for male and female observers. For each bin, I calculated a two-way chi squared analysis to look for differences between observer sex across the four categories (interest areas). For

the 37 viable videos with analyzed head / body interest areas, this led to 3700 chi-squared tests, of which 487 were invalid, due to categories having zero counts. Of the remaining 3413 valid tests, only 93 (2.7%) showed a significant difference between where male and female observers were attending, leading us to conclude that the pattern of information gathering when assessing romantic interest during thin-slices of dating behavior is basically the same for both sexes.

Discussion

My high level results analyzing eye fixation locations at the level of attention to men or women on first dates shows that whichever daters is the target of intention assessment is attended to for the majority of the interaction. However, dating partners are not entirely ignored, as roughly 30% of the time is spent attending to them as well. Observers act as though information is available from both parties, even to answer questions about only one individual. This is in line with data suggesting that coordinated motion and communication between the two individuals in a couple is important for predicting the outcome of their interactions as positive or negative (Grammer, Kruck, & Magnusson, 1998).

This targeted pattern of attention extends to the head and body sub-regions as well, with observers spending the majority of time looking at the head of the individual they are asked about, but also attending to both party's heads and bodies. The majority of time spent looking at the head is most likely due to following the conversational turn-taking of the speakers. While the observers do not know what the daters are saying

(daters are speaking German and observers are non-German speaking American college students) it is natural to follow the flow of the conversation through fixations on the speaker. This could be quantified more precisely through manual coding of the stimuli for who is speaking compared to fixation locations at those time points.

Beyond attending to the target individual (and particularly their head region), observers spend the majority of their time attending to the woman on the date, and in particular her body. There are several potential explanations for why observers spend more time looking at women than men. Women could be presenting more predictive cues, such that looking at a woman provides better information. Another possibility is that women are gesturing, nodding, and smiling more often, so that there are a greater number of cues being generated, and those are garnering more attention. Third, women could be presenting ambiguous cues, such that it takes observers more time to process their meaning and requires greater fixation time to decipher their intentions. While observers who had higher overall accuracies attended to a woman's body more, this does not help us untangle which of these three possibilities for information usage is most plausible. Higher accuracy could come from attending to predictive cues, viewing a greater number of cues, or spending enough time attending to coy cues to know which were predictive and which were deceptive. Further research is needed to pull apart these intertwined possibilities.

My other major finding was that there were minimal sex differences in what information was attended to over the course of the ten second interactions. The only sex difference seen was that observers asked solely about the man's interest tended to look at whichever dater was the opposite sex from themselves. One possible explanation for this

behavior is that predicting male interest is a systematically easier task, and since observers had to wait for the entire interaction to finish before making their judgments, they could have made up their mind about him early on and then attended to whichever person they found more interesting or attractive for the rest of the interaction. As all of my observers were heterosexual, attending more to the opposite sex individual in that case seems plausible. Outside of this one exception, every other comparison including all of the head / body sub-regions and the 100 ms bins compared with chi squared analysis showed no sex differences in fixation patterns.

This leads to two possible explanations of the strategies male and female observers are using to decipher the romantic intentions of others. The first is that all individuals use the same strategy and attend to the same cues to decipher romantic interest in social environments. The second explanation is that men and women use different information sources that my current setup cannot detect, for instance cues that can be accessed without directed eye-movements, and possibly different strategies to process those cues. One cue that has been shown to be predictive in mate choice is global full-body motion (Grammer, et al., 1999). Thus male and female observers in my study could be following a similar pattern of directed attention to fixate and interpret individual cues, but using peripheral cues such as global motion in very different ways. Further experimental procedures would be needed to test this idea, but applying Occam's razor would lead one to expect that it is more likely that similar information processing underlies the similar behavioral outcomes I have seen here.

Supplemental Information

As mentioned in the results section, the total fixation time the observers spend looking in an interest area is a combination of two variables – the length of each fixation, and the number of fixations. There were no deviations in the patterns of these two individual variables from the global fixation time measure, but the significance patterns and results are presented here.

When asked about male interest, on average observers fixated 11.50 times (SEM of .35) on the man and 7.09 (.31) times on the woman, a significant difference, $t(52)=9.47$, $p=.000$, $d=1.84$. When asked about female interest, observers fixated significantly fewer times on the man 6.16 (.31), than on the woman 12.02 (.42), $t(52)=-12.70$, $p=.000$, $d=-2.19$. Again, when observers were asked about the dating intentions of both men and women, they fixated significantly more times on the women than on the men, (10.47, SEM .27 versus 9.72, SEM .25 times) respectively, $t(52)=-3.07$, $p<.003$, $d=-.40$. Observers also fixated more times on the women when asked about male interest than on men when asked about female interest, $t(52)=3.33$, $p<.002$, $d=.42$. There was no significant difference between the number of fixations on the men when they were targets, and the number of fixations on the women when women were targets, $t(52)=-1.31$, $p<.196$, $d=-.19$. Overall, observers looked more times at the women, in all conditions, relative to their importance. When women were not the target, observers looked at them more often than they looked at men when males were not the target, the same pattern of results found for total fixation time. These values are illustrated in Figure 3-3.

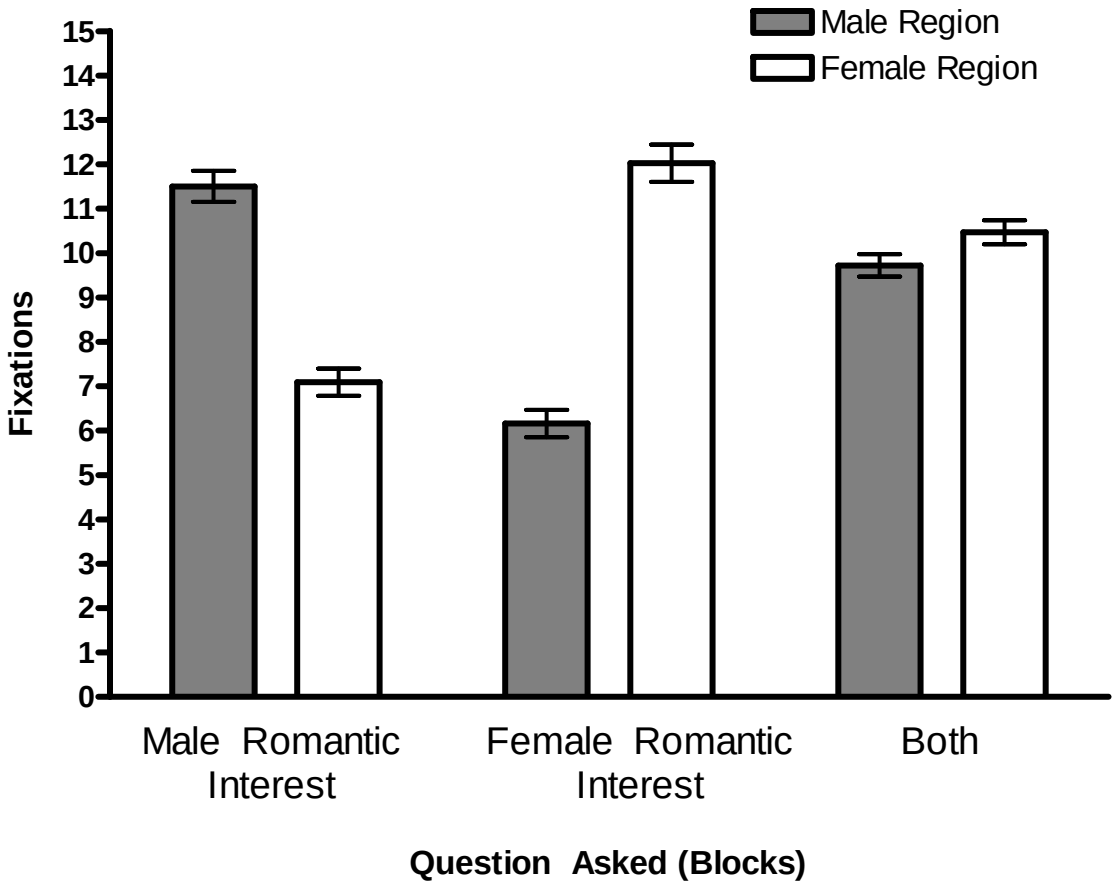


Figure 3-3: Number of fixations on average by each observer in each interest area in each block.

The average length of each fixation was also recorded for the male and female region across all three conditions (see Figure 3-4). Moreover, the same gender differences occurred as for number of fixations: Men made longer fixations on the women when asked about the interest of men than women did, $t(51)=2.33$, $p<.024$, $d= .65$. I found the same overall pattern with the length of fixations as for both the number of fixations (Figure 3-3) and the total fixation time (Figure 3-1).

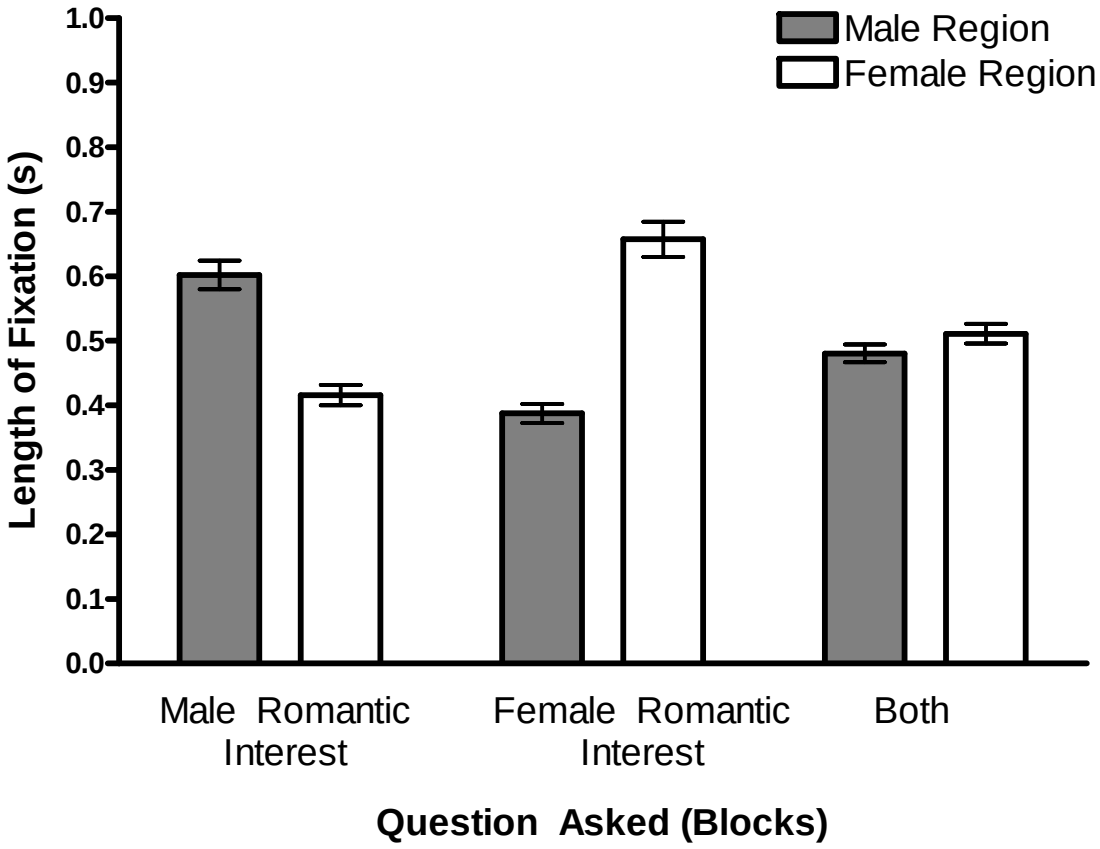


Figure 3-4: Average fixation length in each interest area in each block.

When asked about male interest, observers made longer fixations on the males, mean=601.96 ms (SEM=22.22) than the females, 415.89 ms (15.74), $t(52)=8.00$, $p=.000$, $d=1.33$. When observers were asked about female interest, they fixated longer on the females, 657.19 ms (27.14) than the males, 387.41 ms (108.53), $t(52)=-9.43$, $p=.000$, $d=-1.69$. When asked about the interest of both daters, observers fixated longer on the females, 511.00 ms (15.17) than the males, 480.42 ms (14.91), $t(52)=-2.90$ $p<.006$ $d=-.29$. There were no significant differences in the length of fixations on the non-targets (i.e. females when asked about males and males when asked about females), $t(52)=1.74$,

$p<.087$, $d= .26$. However, for target fixation length (i.e. male when asked about males and females when asked about females) observers had longer fixations on females when asked about females than they did on males when asked about males, $t(52)=-2.82$, $p<.007$, $d=-3.51$.

References:

Abbey, A. (1982). Sex differences in attributions for friendly behavior: Do males misperceive females' friendliness? *Journal of Personality and Social Psychology, 42*(5), 830-838.

Ambady, N., & Rosenthal, R. (1992). Thin slices of expressive behavior as predictors of interpersonal consequences: A meta-analysis. *Psychological Bulletin, 111*(2), 256-274.

Asendorpf, J. B., Penke, L., & Back, M. (in press). From dating to mating and relating: Predictors of initial and long-term outcomes of speed-dating in a community sample. *European Journal of Personality*.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*, 1-49.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204-232.

Carney, D. R., Colvin, C. R., & Hall, J. A. (2007). A thin slice perspective on the accuracy of first impressions. *Journal of Research in Personality, 41*(5), 1054-1072.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Farris, C., Treat, T., Viken, R., & McFall, R. (2008a). Perceptual Mechanisms That Characterize Gender Differences in Decoding Women's Sexual Intent. *Psychological Science, 19*(4), 348-354.

Farris, C., Treat, T., Viken, R., & McFall, R. (2008b). Sexual coercion and the misperception of sexual intent. *Clinical Psychology Review, 28*(1), 48-66.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Grammer, K. (1990). Strangers meet: Laughter and nonverbal signs of interest in opposite-sex encounters. *Journal of Nonverbal Behavior, 14*(4), 209-236.

Grammer, K., Honda, M., Juette, A., & Schmitt, A. (1999). Fuzziness of nonverbal courtship communication unblurred by motion energy detection. *Journal of Personality and Social Psychology, 77*(3), 487-508.

Grammer, K., Kruck, K., Juette, A., & Fink, B. (2000). Non-verbal behavior as courtship signals: the role of control and choice in selecting partners. *Evolution and Human Behavior, 21*(6), 371-390.

Grammer, K., Kruck, K., & Magnusson, M. (1998). The Courtship Dance: Patterns of Nonverbal Synchronization in Opposite-Sex Encounters. *Journal of Nonverbal Behavior, V22*(1), 3-29.

Haselton, M. G., & Buss, D. M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology, 78*(1), 81-91.

Hewig, J., Trippe, R., Hecht, H., Straube, T., & Miltner, W. (2008). Gender Differences for Specific Body Regions When Looking at Men and Women. *Journal of Nonverbal Behavior, 32*(2), 67-78.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Lindgren, K., Parkhill, M., George, W., & Hendershot, C. (2008). Gender differences in perceptions of sexual intent: A qualitative review and integration. *Psychology of Women Quarterly, 32*(4), 423.

McClure, E. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. *Psychological Bulletin, 126*(3), 424-453.

Moore, M. M. (1985). Nonverbal courtship patterns in women: Context and consequences. *Ethology and Sociobiology, 6*(4), 237–247.

Moore, M. M., & Butler, D. L. (1989). Predictive aspects of nonverbal courtship behavior in women. *Semiotica, 76*(3/4), 205-215.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 1113-1135.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in press). Humans show mate copying after observing real mate choices. *Evolution and Human Behavior*.

Place, S. S., Todd, P. M., Zhuang, J., Penke, L., & Asendorpf, J. B. (submitted). Judging romantic interest of others is a cross-cultural ability. *Psychological Science*.

Rupp, H., & Wallen, K. (2007). Sex differences in viewing sexual stimuli: An eye-tracking study in men and women. *Hormones and Behavior, 51*(4), 524-533.

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive Behavior, 10*(2), 113-136.

Thayer, J., & Johnsen, B. (2000). Sex differences in judgement of facial affect: a multivariate analysis of recognition errors. *Scandinavian Journal of Psychology, 41*(3), 243-246.

Thornhill, R., & Grammer, K. (1999). The Body and Face of Woman One Ornament that Signals Quality? *Evolution and Human Behavior, 20*(2), 105-120.

Trivers, R. L. (1972). Parental investment and sexual selection. In C. B. (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Chicago, IL: Aldine-Atherton.

Wiegmann, D. D., & Angeloni, L. M. (2007). Mate choice and uncertainty in the decision process. *Journal of Theoretical Biology, 249*(4), 654-666.

Chapter 4

Observers use motion cues to predict the outcome of romantic encounters

Preface

In chapter three I discovered that when judging the romantic interest between others, there are no systematic differences in the pattern of attention that male and female observers deploy on individual daters, begging the question of where the differences in observer accuracy arise from. The easiest to read daters appear to be attended to in the same way as the hardest to read daters. One possibility is that observers are paying close attention to cues that do not require the changes in foveal fixations that the eye tracker records, and can instead be perceived in the periphery. Such a cue is overall body motion, which has already been implicated in mate choice, due its covariance with romantic interest (Grammer, Honda, Juette, & Schmitt, 1999)—that is, when someone is more romantically interested in their partner, they tend to move around more in general. To test for the role of motion in the perception of romantic interest, I digitally processed the same speed-dating videos I used as stimuli in the previous chapters to remove cues of attractiveness, facial emotion and eye contact leaving only motion cues, general body size cues and clothing cues for the observers to use. As will be described in this chapter, the judgments of romantic interest made by observers watching these altered videos correlated very closely with the judgments reported earlier using the natural videos, implying that motion cues and/or body cues play a major role in the perception of romantic interest. A further control study that removed motion cues and left only body size cues and clothing cues did not exhibit the same correlation with previous judgments, implying that motion may in fact be the most predictive cue of judgments of romantic interest made when viewing naturalistic stimuli.

Introduction

In mate choice, one must gather information about potential suitors—to evaluate both their quality as well as their availability (Simão & Todd, 2002). In a competitive mating market, being able to gather and assess information efficiently becomes an important adaptive skill (Wiegmann & Angeloni, 2007). In addition to gathering information about the attributes of target mates, another source of information is the interest between others, which provides knowledge of the desirability and availability of future potential partners in the local environment. Humans have been shown to possess this ability to recognize interest between others, and can accurately predict the outcome of romantic encounters after observing just thin slices of those interactions (Place, Todd, Penke, & Asendorpf, 2009).

At the macro level, romantic interest is an informative cue during mate choice; however, interest itself is presented through a plethora of micro-level behaviors. Flirtatious signals range from verbal dialogue to laughter and smiling, as well as gesturing and body position (Grammer, 1990; Moore, 1985; Moore & Butler, 1989). In addition to presenting individual cues, signals can be combined into complex patterns that may reverberate back and forth between daters (Grammer, Kruck, & Magnusson, 1998). Men and women could also be displaying different cues, or using the same cues to mean different things (Grammer, Kruck, Juette, & Fink, 2000; Renninger, Wade, & Grammer, 2004). Furthermore, different people could display the same cues with different meanings, making it very difficult to predict which signals are informative in any given situation (Grammer, 1990). Besides the distinct micro cues presented by each

dater, Grammer and colleagues (1999) have shown that valuable information about interactions is contained in the global body motion of the individuals, a phenomenon they term *motion energy*. In videotapes of friendly first-encounter interactions between students, Grammer showed that the total amount of motion, whether it was leaning, arm movements or the crossing and uncrossing of legs, covaried with the romantic interest in the encounters: The more motion an individual displayed, the greater romantic interest that individual had in their partner.

There is thus a wealth of information available within a social interaction, from individual micro cues to patterns of verbal and nonverbal communication to global level motion, some of which is predictive of romantic interest, but most of which is uncorrelated. What cues are observers actually using to when making their judgments of romantic interest between others, and does this vary from observer to observer? To start to find out, I had participants watch videos of first-encounter speed-dating interactions, and had them predict the romantic interest between the daters (Place, et al., 2009--and see Chapter 3). The video clips contained all of the types of flirtation cues described above. While watching the videos, the eye movements and fixations of the participants were recorded, allowing analysis of where the observers were looking when making their judgments (Place, Todd, Penke, & Asendorpf, in prep). Surprisingly, there was very little variance between the observers in terms of where they were looking—everyone seemed to be paying attention to the same cues in each interaction. These patterns included attending to the faces of the daters, as if following the conversation (videos included audio).

However, the observers differed in their accuracy at predicting the romantic interest between the speed-dating couples. This could mean that observers are attending to the same cues but processing them in different ways. Or it could be that observers are in fact using different cues (as is supported by the observation that highly accurate observers attended to the women's body at greater frequencies than did low accuracy observers), possibly even cues that do not require directed attention to be perceived. Cues such as the global body motion described by Grammer (1999) can be perceived in the periphery. While Grammer has shown that this information is present in interactions, it is not known whether people are aware of it, associate it with romantic interest, or can perceptually extract it from naturalistic scenes.

In the present study I seek to answer these questions, by asking observers to judge romantic interest in videos of dating interactions that have had many of the micro-level cues removed, leaving just high-level cues such as global motion (and several others) behind. There is some suggestive evidence supporting the idea that global motion may be used during these kinds of assessments: Judgments of romantic interest have been shown to operate cross-culturally in a way that is consistent with the use of global motion as a cue (Place, Todd, Zhuang, Penke, & Asendorpf, submitted--and see Chapter 2). The researchers showed the same videos of Germans speed-dating to American, German, and Chinese participants and found high correlations between the three population samples for the accuracy in judging the intent of particular individual daters. Because differences in both language comprehension and familiarity with western European cultural and dating norms would likely have rendered micro-level cues difficult to assess in the same way across all three cultures, global motion cues instead could have played an important

role in enabling these participants to reach similar conclusions about the romantic interest of daters in the interactions. Based on this suggestion, I therefore hypothesize that when micro cues are removed and observers of dating interactions are forced to rely on motion cues to judge interest, they will be just as accurate as when they view unaltered naturalistic stimuli. Furthermore, if motion cues are one of the major sources of information used when making these judgments, then I predict that observers seeing only motion cues will still produce *the same* patterns of readability across individual daters, such that the daters who were easy to read in previous studies using unaltered video remain easy to read when only their body motion is available.

There are several ways to extract motion cues from videos of behaving human bodies (Berry, Kean, Misovich, & Baron, 1991), the two most popular being point light displays (Johansson, 1973; Kozlowski & Cutting, 1977) and quantizing videos (Harmon, 1973; Morrone, Burr, & Ross, 1983). Point light displays are a considerable abstraction from behavior as we usually observe it, because they remove all the original content and present only the motion of points corresponding to the major joints. I did not use point light displays as the technology would have to have been employed at the time of the speed-dating sessions, and making the daters wear the required markers on their joints would likely have affected the naturalness of the interactions. Instead I chose to quantize the videos after they were recorded, by greatly reducing their resolution and clarity such that the images of the daters became blurry amorphous blobs that swayed back and forth in their chairs. The downside of using this form of quantizing is that not all information is removed besides motion. The dater "blobs" contain clothing cues as well as body size (including body mass index, or BMI), which have been shown to be important during

mate choice (Tovée, Maisey, Emery, & Cornelissen, 1999; Tovée, Reinhardt, Emery, & Cornelissen, 1998). To control for this, I ran a second study that removed a cue that I could completely eliminate: the motion cue itself. Therefore in Experiment 1, observers viewed quantized video displays of romantic first encounters that contained both high-level motion cues and BMI and clothing cues. In Experiment 2, observers viewed quantized still pictures of the same daters, which contained only the BMI and clothing cues. Comparing the judgments of romantic interest between the two studies, and to previous work using naturalistic displays of the same individuals, will allow us to analyze the role of global motion in the prediction of romantic interest.

Methods

Subjects

Experiment 1 included 84 participants, 41 men (mean age: 19.0) and 43 women (mean age: 18.7). Experiment 2 included 50 participants, 19 men (mean age: 19.7) and 31 women (mean age 19.5). Participants were recruited from the Indiana University psychology subject pool and were compensated with research credits required for undergraduate coursework. Participants were screened to be over 18 years old, heterosexual, and with no knowledge of the German language (because the stimuli were in German; see next section). Informed consent was received from each participant before the start of the experiment.

Stimuli

The stimuli used in this experiment consist of photos of individuals, and videos of the same individuals on speed-dates. These stimuli come from the Berlin Speed Dating Study (BSDS) (for details see: Asendorpf, Penke, & Back, in press; Place, et al., 2009), a set of carefully controlled experimental speed-dating sessions run at Humboldt University in Berlin. Speed dating is designed to allow singles to meet a large number of possible suitors in a short period of time (Finkel, Eastwick, & Matthews, 2007). In a typical speed-dating session, roughly a dozen men and a dozen women meet in pairs and get to talk for 2 to 5 minutes. At the end of each conversation, individuals record their interest in seeing the other person again, and after the session mutually interested pairs are given each others' contact information, so they can arrange another meeting.

In this experiment, 24 men and 24 women from 2 different speed-dating sessions of singles in their 20's were used in the stimuli (same daters as: Place, et al., 2009; Place, et al., submitted). Dates were picked to have no repeats: each of the 24 interactions were between unique men and women. Videos of each of the 24 three-minute dates were cut into 6 different clips—a 10 second and a 30 second clip from each of the beginning, middle and end of the date. These clips were composite videos from two camera angles, each over the shoulder of one of the daters. These composite clips presented both daters clearly. Each video was then quantized and blurred per frame. Quantizing removed an order of magnitude of detail, such that the 700 x 288 video was converted into a grid of 70x28 blocks, representing the average color and luminance in each block. These blocks were then blurred, creating a ghostly feature less presentation. This process removed all facial features (including facial attractiveness, eye contact and facial expressions) as well

as substantially blurring clothing cues and detailed gesturing (movements of individual fingers). The cues that were left were generalized motion (including leaning / torso motion, arm motion and gesturing, and leg motion / crossing and uncrossing) as well as an overall body size and height (a rough estimate of body mass index, BMI) and rough clothing cues. An example video frame is shown in Figure 4-1.

Figure 4-1: Example stimuli for experiment 1. Videos are quantized and then blurred, masking individual facial features and physical attractiveness.

Forward facing photographs of each of the 48 individuals were cropped and normalized to be the same size of the video clips, and were presented side-by-side in the same dating pairs to mimic the video presentation. Individuals' entire bodies were shown, standing with their arms at their side (pictures were taken immediately before the start of the speed-dating sessions, so all clothing cues were identical). Photographs were treated with the same quantizing and blurring algorithms as were applied to the videos, leaving BMI and clothing as the only clear cues (as static pictures contain no motion cues).

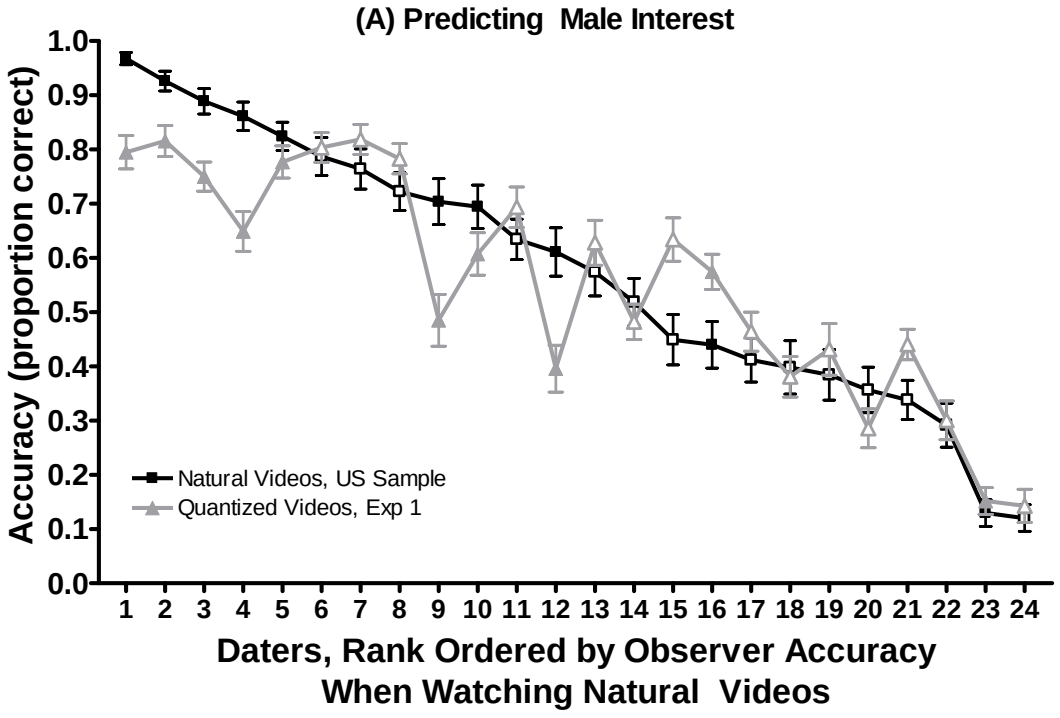
Procedure

Participants first answered a brief survey concerning their age, gender and relationship status. In experiment one, observers followed the same procedure as used previously (Place, et al., 2009), with the exception that they viewed the blurred quantized videos instead of normal videos. Following each ten or thirty-second video presentation, observers answered two yes / no questions, “Do you think the man was interested in the woman?” and “Do you think the woman was interested in the man?” For each of the 24 interactions I used, each participant saw four clips (in randomized order, both within and across interactions), 10-second clips from all three locations (10 beginning, 10 middle, and 10 end) and one 30-second clip from a location that was randomized across interactions. In experiment two, instead of viewing altered videos, observers were presented with paired pictures of the same 24 sets of daters. Each picture set was displayed for 10 seconds, after which the pictures were removed and the same two questions were presented sequentially. Participants saw each 10 second picture presentation once.

Results

The responses generated by the observers to predict the romantic interest of the man and the woman on the date were compared to the reported interest by the actual daters to create an accuracy measure. In experiment one, when viewing quantized videos, the overall accuracy for predicting the intentions of the male daters was .55 (SEM .01),

and .54 (.01) for the female daters, similar to previous work using unaltered videos of the same dates (Place, et al., 2009; Place, et al., submitted). However what we are really interested in is not global accuracy, but individual dater accuracy—are observers equal in their performance at predicting the interest of an individual when they are limited to just motion and body mass cues as when they are presented with the full set of non-verbal and verbal cues. As there is great variance in the readability of different individuals, the average performance could be quite similar across experiments when in fact the readability of individual daters has changed dramatically. To measure these individual dater similarities, the accuracy at predicting the interest of each of the 48 daters (24 men and 24 women) from this limited information sample (quantized videos) was compared to the full information sample gathered from a similar American college student population. Strong correlations were found for predicting the interest of both the men and the women. For male interest, the accuracy for the quantized video from experiment1 correlated at r=.89, p=.000 to the full information US sample and r=.66, p=.000 for predicting female interest. Figure 4-2 presents these results, comparing results from experiment 1 to the full information US sample, for predicting male interest (A) and female interest (B).


(A) Predicting Male Interest
Accuracy (proportion correct)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Natural Videos, US Sample
Quantized Videos, Exp 1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Daters, Rank Ordered by Observer Accuracy
When Watching Natural Videos

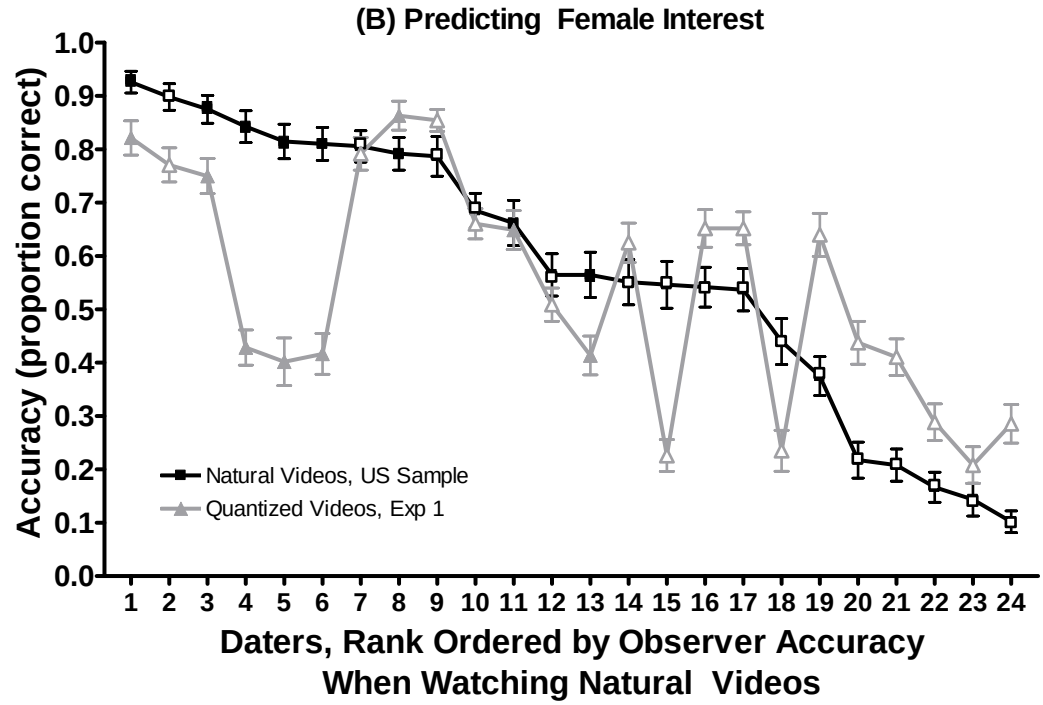
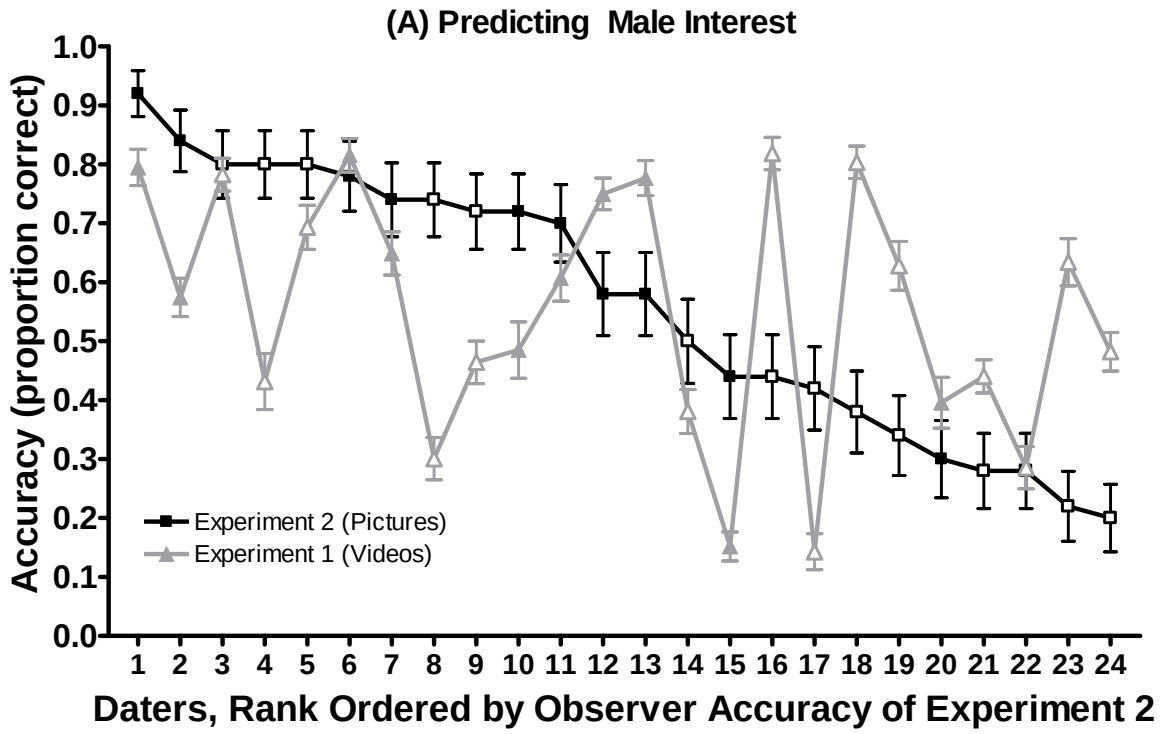

(B) Predicting Female Interest
Accuracy (proportion correct)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Natural Videos, US Sample
Quantized Videos, Exp 1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Daters, Rank Ordered by Observer Accuracy
When Watching Natural Videos

Figure 4-2: Comparing the accuracy at predicting the interest of each dater, for the natural videos presenting full information sample gathered previously to the quantized videos presenting limited information from experiment 1. Error bars are +/- 1 S.E.M. Open symbols represents trials were the dater was not interested in their partner, while closed (filled in) symbols represent trials were interest was reported. Panel A is for predicting the interest of the male daters, while Panel B is for female daters.

The results from experiment one show that motion cues, body mass (BMI) cues and clothing cues provide enough information to equate performance from watching full naturalistic videos. However to disentangle the influence of these three cue types, one cue needs to be removed while the others remain. In experiment two, the motion cues are removed, leaving BMI and clothing cues as the only sources of information to make judgments of romantic interest. If motion is the actual cue driving these accurate judgments, then I would expect the per-dater accuracy from experiment two to not correlate with the data from experiment one or the data from the full video presentations. This is exactly what the data show, neither predicting male nor female interest from quantized pictures correlates significantly with quantized videos or natural videos. The daters who were easy to read from videos containing motion information are now no longer easy to read. However, performance at judging romantic interest from quantized pictures containing body mass and clothing information is not at chance—observations are not random. There are still systematic decisions being made across the observers, and there are still individuals who are very easy to read (over 80% correct perceptions) and

some individuals who are very difficult to read (under 20% correct perceptions). However these are *not the same people* as were easy to read in the other experiments. Figure 4-3 compares the per-dater accuracy for experiment one (quantized videos) and experiment two (quantized pictures), for predicting both male interest (A) and female interest (B).



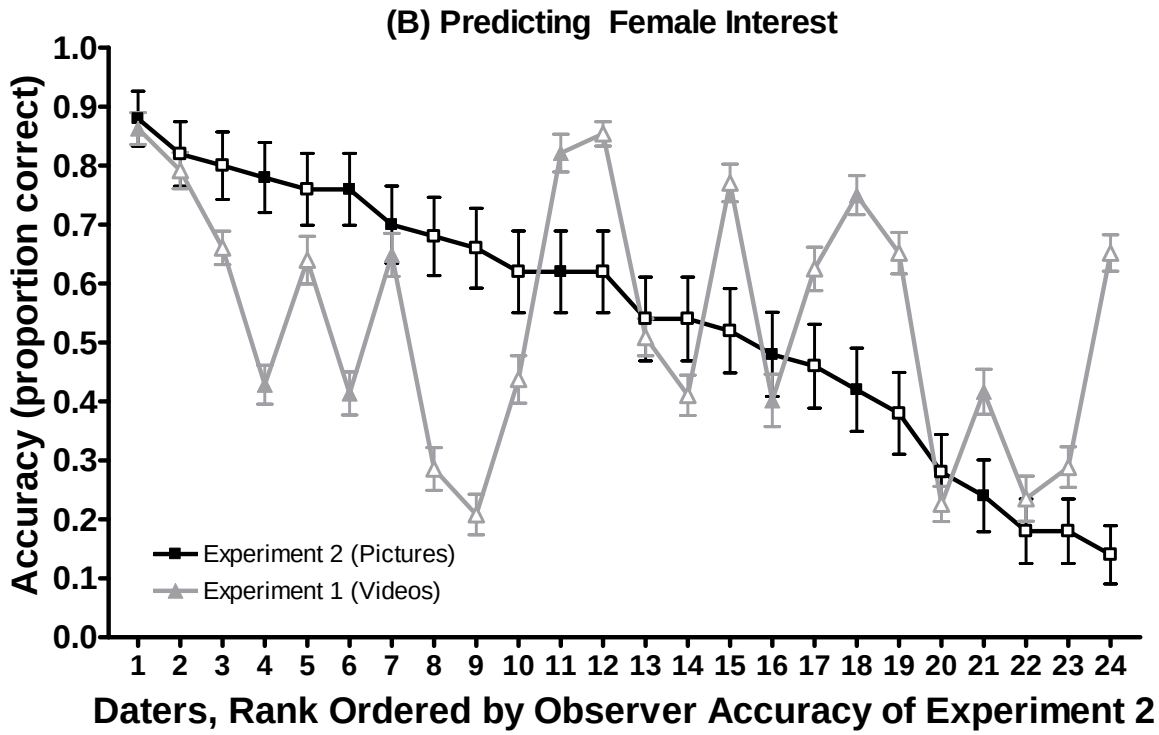


Figure 4-3: Comparing the accuracy at predicting the interest of each dater, for the quantized pictures presenting only BMI cues from Experiment 2 to the quantized videos presenting BMI and motion cues from Experiment 1. Error bars are +/- 1 S.E.M. Open symbols represents trials were the dater was not interested in their partner, while closed (filled in) symbols represent trials were interest was reported. Panel A is for predicting the interest of the male daters, while Panel B is for female daters

Discussion

The results support my hypothesis that motion cues may be one of the most informative and useful cues when making judgments of romantic interest from naturalistic stimuli. When observers view video tapes of first-encounter speed-dating sessions, they are just as accurate at perceiving the interest between the daters if the video tapes are quantized and visible cues are reduced, than as when they watch the full naturalistic encounters. These results support the idea that motion, and in particular global motion energy plays an important role in romantic encounters (Grammer, et al., 1999). It also helps explains why recordings of directed attention through eye fixations showed no individual level patterns for specific cues (Place, et al., in prep). However these results do not provide any insight into how the quantity or timing of motion plays a role in the interactions. I do not have any quantitative measure of the motion in the interactions, so I cannot tell if more motion leads to more interest, or if motion is more predictive if generated by the man or the woman on the date. Future work is needed to accurately describe the motion on each date, and how its characteristics are interacting with presentation of romantic interest on the dates.

The data from experiment two, while originally designed as a control study have also brought new insight. First, the results further support the global motion hypothesis, as judgments of interest from stimuli presented without motion do not correlate with judgments from stimuli with motion. This control allows us to eliminate the role of body mass and the limited clothing cues present as the driving force behind the perceptions from experiment one. However, the performance in experiment two was not at chance,

and there were systematic differences in the ability to judge certain individuals. This data shows that when certain cues (such as motion) are removed, the observers rely on different cues, which lead to a new readability for each dater. This hierarchal cue use could be present in naturalistic stimuli as well. In most cases, the quantized video presentations lead to similar, but not identical results to the natural videos. Motion could be the cue that is used most of the time, but in certain instances, when another cue's validity is very high, it can be used in addition. Body mass is such a cue, and one could imagine that verbal content, tone of voice and other micro level cues could be informative (or thought to be informative) in particular instances. Multiple cue use in mate choice is an already accepted notion (Candolin, 2003), as it is clear that many attributes are driving interest, and the presentation of interest. Motion however seems to be higher up the hierarchy, as it correlates the closest with the accuracy when presented with videos that contain all the possible cues.

Future work would be needed to catalogue the other cues (such as BMI) in each interaction, and to try to quantify the validity of each cue. This could be based on not only the value of one dater, but also the difference between the two daters. Perhaps dates with the largest discrepancies between daters (whether it be BMI, motion, or another cue) provide the most informative cases of that particular cue. It would then be possible to examine the cases where accuracy is very different between natural videos, quantized videos, and quantized pictures, and try to better understand which specific cues were driving the correct perception in one case, and the misperception in another. Overall this work has shown the importance of motion as a cue to accurately predict the romantic interest between others, and further shown that many cues can in fact be informative, and

when given impoverished stimuli, humans are able to adjust their decision criterions and still make accurate perceptions.

References:

Asendorpf, J. B., Penke, L., & Back, M. (in press). From dating to mating and relating: Predictors of initial and long-term outcomes of speed-dating in a community sample. *European Journal of Personality*.

Berry, D., Kean, K., Misovich, S., & Baron, R. (1991). Quantized displays of human movement: A methodological alternative to the point-light display. *Journal of Nonverbal Behavior, 15*(2), 81-97.

Candolin, U. (2003). The use of multiple cues in mate choice. *Biological Reviews, 78*(4), 575-595.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Grammer, K. (1990). Strangers meet: Laughter and nonverbal signs of interest in opposite-sex encounters. *Journal of Nonverbal Behavior, 14*(4), 209-236.

Grammer, K., Honda, M., Juette, A., & Schmitt, A. (1999). Fuzziness of nonverbal courtship communication unblurred by motion energy detection. *Journal of Personality and Social Psychology, 77*(3), 487-508.

Grammer, K., Kruck, K., Juette, A., & Fink, B. (2000). Non-verbal behavior as courtship signals: the role of control and choice in selecting partners. *Evolution and Human Behavior, 21*(6), 371-390.

Grammer, K., Kruck, K., & Magnusson, M. (1998). The Courtship Dance: Patterns of Nonverbal Synchronization in Opposite-Sex Encounters. *Journal of Nonverbal Behavior, V22*(1), 3-29.

Harmon, L. (1973). The recognition of faces. *Scientific American, 229*(5), 71.

Johansson, G. (1973). Visual perception of biological motion and a model for its analysis. *Perceiving events and objects*.

Kozlowski, L., & Cutting, J. (1977). Recognizing the sex of a walker from a dynamic point-light display. *Perception & Psychophysics, 21*(6), 575-580.

Moore, M. M. (1985). Nonverbal courtship patterns in women: Context and consequences. *Ethology and Sociobiology, 6*(4), 237–247.

Moore, M. M., & Butler, D. L. (1989). Predictive aspects of nonverbal courtship behavior in women. *Semiotica, 76*(3/4), 205-215.

Morrone, M., Burr, D., & Ross, J. (1983). Added noise restores recognizability of coarse quantized images. *Nature, 305*(5931), 226-228.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in prep). Men and women attend to the same cues during judgments of romantic interest.

Place, S. S., Todd, P. M., Zhuang, J., Penke, L., & Asendorpf, J. B. (submitted). Judging romantic interest of others is a cross-cultural ability. *Psychological Science*.

Renninger, L. A., Wade, T. J., & Grammer, K. (2004). Getting that female glance: Patterns and consequences of male nonverbal behavior in courtship contexts. *Evolution and Human Behavior, 25*(6), 416-431.

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive Behavior, 10*(2), 113-136.

Tovée, M., Maisey, D., Emery, J., & Cornelissen, P. (1999). Visual cues to female physical attractiveness. *Proceedings of the Royal Society B: Biological Sciences, 266*(1415), 211.

Tovée, M., Reinhardt, S., Emery, J., & Cornelissen, P. (1998). Optimum body-mass index and maximum sexual attractiveness. *Lancet, 352*(9127), 548-548.

Wiegmann, D. D., & Angeloni, L. M. (2007). Mate choice and uncertainty in the decision process. *Journal of Theoretical Biology, 249*(4), 654-666.

Section 2

The Influence of Others' Mate Choice Decisions

In mate choice, a great deal of information is available in our social environment to extend our directly gathered perceptions of potential mates. In section one I discussed new experimental data that presents an adaptive ability in humans to accurately perceive the romantic interest between others. I now look to see how this information in the social environment affects an individual's own mate choice decisions. One can imagine that social information and the opinions of others in the local environment could influence an observer's decision in several different ways (Westneat, Walters, McCarthy, Hatch, & Hein, 2000). Perhaps the perception of interest by others in a target mate would lead to decreased interest on the part of the observer, as they would realize pursuing this mate would lead to increased competition and a lower chance of success. The opposite is also possible: Observers could be more interested in a target mate due to the increase in that individual's perceived value when others are also interested. Here I explore these possibilities, and find that in almost all cases, observers are positively influenced by their peers and show increased interest in a target mate when same-sex peers are also interested. This effect, known as mate choice copying (Pruett-Jones, 1992), was first documented in guppies and quail (Dugatkin, 1992; Galef & White, 1998), and has now been found in humans by several research groups using complementary methods (Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Little, Burriss, Jones, DeBruine, & Caldwell, 2008; Waynforth, 2007; Yorzinski & Platt, 2010).

In section two I present my findings on mate choice copying in humans, which extend the limited and conflicting research currently in the field. In chapter five I present my new externally valid mate choice methodology, which utilizes the naturalistic videos of speed-daters that were featured prominently in section one. While these results were

the first of their kind to show mate copying in humans when originally gathered, by the time of publishing they augment a growing body of research on this topic. The results extend the existing literature by presenting mate copying not only using naturalistic stimuli, but also by showing complex mediations of the effect through the attractiveness comparisons of the observer and the couple being observed. Once my method had been validated I extended and improved on it in chapter six, by asking not only about the presence of romantic interest between the couple observed, but also the strength of that relationship, and the confidence the observer had in his or her perceptions. This allowed us to see if observers were mate copying in all instances, or only when they believed strongly in what they had seen. As mate copying is only an effective strategy if the validity of the observed information is high, it comes very important that observers are disciplined in their selections. I further probed the effect of information validity by changing the quality of information observers saw, by replacing the naturalistic video of either the man or the woman in the interaction with a static picture, thus greatly reducing the social information available to an observer. In addition, the data in chapter five comes from a 4000+ person internet sample, which allowed us to look for individual differences in age, relationship status, geographic location, and culture among the participants. These findings augment not only the generalizability of mate choice copying outside of typical college-aged samples, but also represent the first look into the social information use of individuals in committed relationships for potential extra-marital affairs.

Finally, in chapter seven I differentiate between two different types of mate copying, and look to see if individual differences in the observers could dictate which kind of mate copying they engage in. While all previous research in humans has looked at

individual mate copying, wherein an observer shows greater interest in the same target that they perceive others are interested in, another form of mate copying has also been found in non-human animals (Godin, Herdman, & Dugatkin, 2005; Swaddle, Cathey, Correll, & Hodkinson, 2005): *trait-based* mate copying, when an observer notices the traits of the target that others are interested in, and then shows a generalized increased interest to other potential mates who share those traits with the original target. I first look for this effect in humans in general, and then look to see if individual differences in personality, sexual history, and mate choice goals dictate the strategies used by observers.

Section two presents a variety of new data that augments and expands the existing literature on mate choice copying in humans. Using naturalistic stimuli and real mate choice decisions, these behavioral experiments show not only how mate copying can be used in conjunction with other mate choice strategies, but also when and why individuals would choose to use social information gathered locally from their peer environment.

All work in section two has been done in collaboration with Peter Todd, Lars Penke and Jens Asendorpf. Chapter five has been published in Evolution and Human Behavior: (Place, Todd, Penke, & Asendorpf, in press) while chapters six and seven are in preparation for submission.

Chapter 5

Humans show mate copying after observing real mate choices

Preface

I start the second section with an exploration of the mate copying effect in humans. While previous research has shown mate copying using pictures and staged relationships, I looked to find this use of social information through presentation of naturalistic first-encounter stimuli, through videos of speed-dating videos. In addition, by independently assessing the attractiveness of both the observer and the individuals on the dates, I could learn if individuals were copying any mate choice selections, or if attractiveness mediated these copying decisions. These results add to the evidence that humans do in fact utilize social information during mate choice.

Introduction

In mate choice, in order to determine the value of potential mates individuals must gather information. One source of such information is the mate decisions of others. By focusing on potential mates (or their particular qualities) who have been chosen by others, mate choices can be influenced by another's successful search. This process, known as mate copying (Dugatkin, 1992, 2000) has been widely documented in many animal species, mostly birds (Freed-Brown & White, 2009; Galef, 2008; Galef & White, 1998) and fish (Alonzo, 2008; Dugatkin, 1992). While many people may feel that their choice of a mate is an intensely personal and individual process, biologists have hypothesized that mate copying could also be present in humans (Brown & Fawcett, 2005; Dugatkin, 2000), and recent research has supported this idea (Eva & Wood, 2006;

Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Little, Burriss, Jones, DeBruine, & Caldwell, 2008; Waynforth, 2007); it may also underlie other sexual interactions including mate poaching (Schmitt & Buss, 2001). In non-human animals, mate copying has been studied primarily in the decision making of females, who are allowed to observe the courtship displays of males and the selections made among those males by their female peers. In humans, however, where mate choice decisions are typically mutual, men and women alike are choosing mates and being selective based on cues of mate value, particular for long-term mating decisions (Todd & Miller, 1999; Todd, Penke, Fasolo, & Lenton, 2007). Thus it is reasonable to expect that using social information could inform the decisions of both men and women, as has been found for animals with mutual mate choice (Frommen, Rahn, Schroth, Waltschyk, & Bakker, 2008). However, studies looking for these effects in humans have yielded mixed results, with some finding mate copying in both sexes (Little, et al., 2008) while others found differences between the sexes (Hill & Buss, 2008), pointing to the need for further experimentation and perhaps new experimental designs.

Despite the present surge of interest in human mate copying, all of the studies published to date do not incorporate a key component of this phenomenon: the necessity of accurately determining whether an individual being observed has chosen a particular other individual as a mate. For mate copying to make adaptive use of social information, the focal (observer) individual has to know when the model (the observed individual of the same sex as the observer) actually has mating interest towards the target (the opposite-sex observed individual); otherwise the observer could copy an instance of non-interest and thereby make a poor mate choice decision.

Current paradigms to test mate copying in humans obviate the need for an observer to infer a model's mating interest, by presenting observers with a single explicit cue of a model's romantic interest or attraction toward each target. This has been done for instance by labeling photos of a target and model side-by-side as "in a relationship" (Eva & Wood, 2006; Little, et al., 2008; Waynforth, 2007) or by showing photos of targets paired with smiling opposite sex models (Jones, et al., 2007). This approach means that participants learn about the status of a relationship through social communication, bringing along with it issues of the authority and believability of the source of that communication (e.g., the experimenter). Each study has a somewhat different presentation methodology, but most compare pre-test or baseline ratings of attractiveness to ratings obtained in conditions where mating interest is present. This can involve comparing ratings of photos labeled as single or in a relationship, seen by different subjects (Eva & Wood, 2006), or comparing unlabeled paired photos to labeled paired photos, within subjects (Waynforth, 2007), or comparing photos shown alongside attentive smiling versus neutral-expression members of the opposite sex, within subjects (Jones, et al., 2007). Researchers then analyze the differences between target attractiveness ratings made by observers before getting the mating information and after, to see whether the explicit cue of mating interest made the targets appear more attractive—an indication of mate copying. The study by Little and colleagues (2008) was different in that there was no control condition, and only pictures of paired couples were presented, with each picture being either masculinized or feminized to increase or decrease its attractiveness. The changes in observer interest toward the targets were then compared based on the degree of these morphological alterations.

In contrast, for non-human animal studies, researchers create settings where model and target individuals are able to interact naturally and make their own mate choices, which observers can witness in full (Dugatkin, 2000). Rather than the human studies' presentations of still photos of purported mates, whom the observers might perceive as not even being a legitimate realistic couple, the animal study stimuli are dynamic interactions with the full set of body motions, vocal calls, and other social signals that are integral to the species' courtship and mate choice process. Obviously, there is a large gap between the minimalistic stimuli used in human mate copying experiments and the rich environments of animal research. This could be important for interpreting the results of recent human experiments: Are typical processes and levels of human mate copying elicited via still photos and single explicit cues of mating interest? Would human participants engage in less or more mate copying if they had to infer that interest themselves on the basis of observing real social interactions? Bridging the gap in experimental design by using more realistic presentations of interpersonal mating interest would give us a fuller understanding of when and how human mate copying happens in the real world, and could help overcome the small (or null) effect sizes and sometimes contradictory results of existing studies (Eva & Wood, 2006; Hill & Buss, 2008; Jones, et al., 2007; Little, et al., 2008; Uller, 2003; Waynforth, 2007).

To surmount the restrictions of using pictures of individuals as stimuli, I presented my participants with video clips of pairs of actual singles on real speed-dates. This allowed two key changes in methodology: First, there were no explicit interest labels, and instead participants were told to judge the couples' interest in the interactions. Therefore instead of comparing judgments based on assigned categories (such as single

or in a relationship), I can compare ratings based on how the participants perceived the success of the interactions. Second, by using video clips, participants were able to see and hear actual human mate choice interactions, so that multiple cues including tone of voice and nonverbal behavior could influence their interest judgments and their own ratings of the targets—and hence any mate copying that might occur. In addition, similar to the methodology of Little et al. (2008), I used measures of short-term and long-term relationship interest toward the targets (instead of just physical attractiveness ratings) to better understand when mate copying is used in mate choice.

Speed-dating as a research design aims to simulate initial mating relationship encounters at zero acquaintance, and since it is usually done with real singles and consequential choices, it does so more naturalistically than most other designs (Finkel, Eastwick, & Matthews, 2007; Penke, Todd, Lenton, & Fasolo, 2007).While speed-dating does not reflect mate choices that develop out of existing social relationships (e.g. friendships or work relationships), it likely captures a process involving newly encountered individuals that is relevant to many modern-day mate choice decisions and that could also have been important (even if infrequent) in our evolutionary past. Furthermore, it is analogous to laboratory mate copying work with other species where researchers use individuals who are not socially familiar with each other, and these results have been found to generalize to behavior in nature (Alonzo, 2008).

Mate copying could function as a shortcut for learning about features relevant to an individual animal's mate value that are not fully observable at first glance (Hill & Ryan, 2006), a possibility that has also been proposed for humans (Little, et al., 2008). While studies have shown that valid information on all kinds of characteristics relevant

for mate choice, including not only physical traits but also personality traits and intelligence (Borkenau, Mauer, Riemann, Spinath, & Angleitner, 2004) and socioeconomic status (Kraus & Keltner, 2009), can be gathered from short observations, these quick initial judgments vary in accuracy. Since the accuracy of person judgments increases over time with acquaintance (Biesanz, West, & Millevoi, 2007; Funder & Colvin, 1988), the accuracy of first impressions could be improved by combination with the impressions formed by others over longer periods of interaction with the target individual. In line with this, models of adaptive mate copying situations in monogamous species predict the highest rates of copying when females can be sure that others have had enough time to learn about and judge males (Dubois, 2007). Additionally social information (and mate copying) could be used as a measure of social popularity and prestige, which are typically more prominent in short-term mate choice (Buss & Schmitt, 1993). In either case, the decision to copy another's mate selection could stem from simply the presence of same-sex interest, or it could involve assessing the mate values of the model and target, or even how the model's and target's mate values compare to that of the observer (Hill & Ryan, 2006; Vukomanovic & Rodd, 2007; and see discussion in Vakirtzis & Roberts, 2009; Witte & Godin, in press). To test for these possibilities, I first gathered independently-rated attractiveness measures of the models and targets as proxies for their mate value, and then used these values to test whether observers blindly copied the selections of all models or if they were affected by *absolute* model mate value. I also compared model and target attractiveness ratings to self-attractiveness ratings made by the observers to see if the *relative* mate value of models and targets influenced observers' mate copying.

In sum, I designed this study to look for effects of mate copying in both short-term and long-term mate choice, by both sexes, and among targets, models, and observers with different absolute and relative mate values. While I expected both men and women to utilize mate copying because both sexes need to gather information on potential mates that might not be available on first glance to make adaptive mate choice decisions, the manner in which they are influenced by the social information could differ.

Methods

Participants

Observers comprised 40 women (mean age 20.0) and 40 men (mean age 19.8) recruited from the Indiana University psychology participant pool and compensated with course credit. All were over 18 years old, heterosexual, and with no knowledge of the German language (because the stimuli were in German; see next section).

Stimuli

I used photos of individuals and videos of the same individuals on speed-dates taken from the Berlin Speed Dating Study (BSDS), carefully controlled speed-dating sessions run at Humboldt University in Berlin (for details see methods of: Place, Todd, Penke, & Asendorpf, 2009). Speed-dating is designed to allow singles to meet a large number of possible suitors in a short period of time (Finkel, et al., 2007). All BSDS participants were actual singles from the general population motivated to find a partner. At the end of each three minute speed-date, individuals recorded whether or not they were interested in seeing the other person again, and after the session mutually interested

pairs were given each others' contact information, so they could arrange future meetings. For this experiment, stimuli were created from the interactions of 8 men and 8 women (all in their 20's) from 3 different speed-dating sessions.

The 16 individuals used in my stimuli were selected to have had at least one date where there was mutual interest, which I showed to one set of participants, and a different date where there was mutual disinterest, shown to the other participants. This partially removed the impact of individual differences in target and model attractiveness and other features from my key variable, romantic interest. Both participant groups saw 4 positive and 4 negative interactions, and were explicitly informed that the videos (in contrast to the natural distribution of speed-dating interactions) all showed either mutual interest or mutual disinterest, with 50% of each type.

Frontal facial photographs of each of the 16 individuals smiling were cropped to reduce cues from clothing, and their size was standardized to identical interpupillary distance. Videos showed 10 seconds of interaction from the exact middle of each 3-minute date, as previous research (Place, et al., 2009) demonstrated that this length and location results in high accuracy for participants' ratings of romantic interest. The videos were framed to capture body language and potential eye contact, and included conversation in German.

Procedure

Participants reported their age, sex, and relationship status, and also rated their self-perceived attractiveness via a single item measure, "How attractive do you think you are?" (from 1=very unattractive to 9=very attractive). Participants then viewed randomly-

ordered photos of the 8 opposite-sex daters (targets), and made two ratings (from 1=not very interested to 9=very interested) of each: a short-term relationship measure, "How interested would you be in this person as a short-term partner for a brief affair or a one-night-stand?", followed by a long-term relationship measure, "How interested would you be in this person as a long-term partner for a committed, exclusive relationship?" Next, participants watched video clips of each just-rated target individual interacting with another person (the model) in a speed-date. Participants judged the mutual romantic interest present in each interaction and answered "Do you think the couple were interested in / attracted to each other? (yes/no)" Following each video, the photo of the opposite-sex target in that clip was presented again, and participants re-rated that individual on the two interest measures. This process was repeated for all eight interactions.

Results

To look for mate copying effects, I assessed participant observers' change in their own romantic attraction to the opposite-sex speed dater targets as a consequence of the social information they *perceived* from watching the videos—that is, whether they thought the model was interested in the target. Figure 5-1 presents these results for both short- and long-term relationship ratings made by male and female observers.

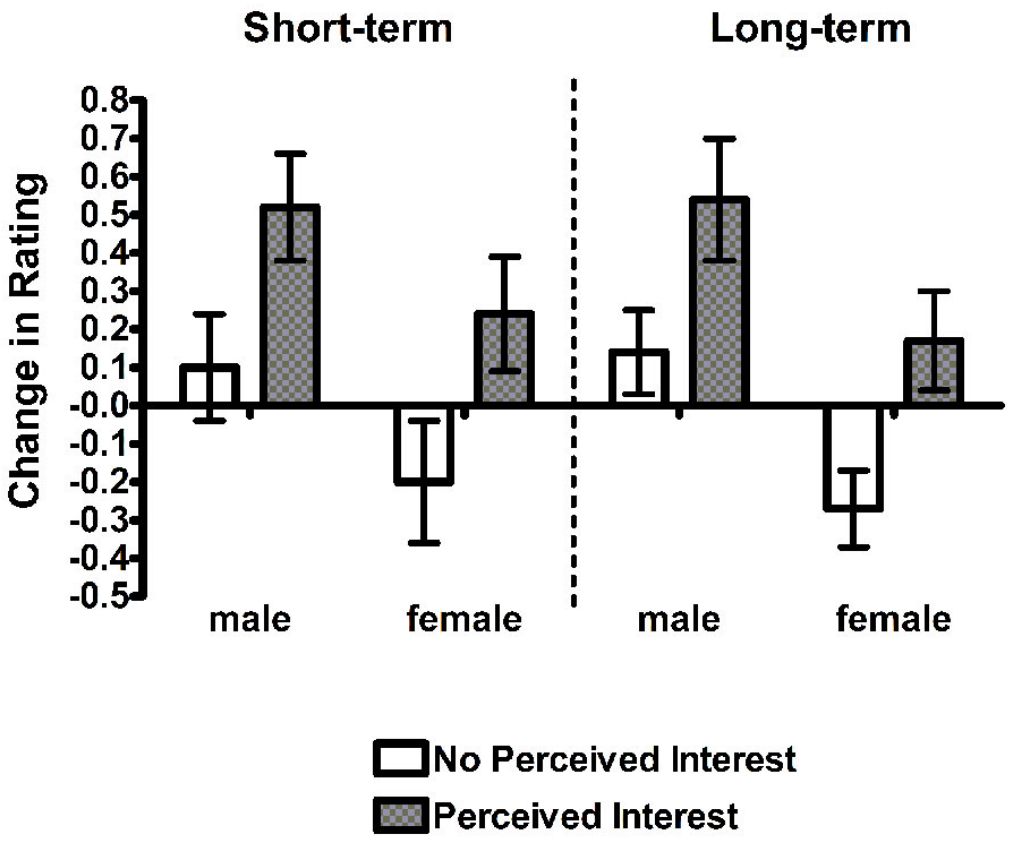


Figure 5-1: Changes in ratings of target attractiveness for short- and long-term relationships, separated by perceived interest (present or absent), made by male and female observers. Error bars are +/- 1 S.E.M. Mate copying is measured in terms of the difference

For rating changes for short-term relationships (STR), both male and female observers showed significant mate copying effects, seen in Figure 5-1 by comparing the perceived-interest bars to their respective no-perceived-interest bars, $t(39)=-3.13$, $p<.003$, $d=.49$ for female observers and $t(39) = -2.83$, $p<.007$, $d=.39$ for males. These same

differences in rating changes were also present for long-term relationships (LTR) in both sexes, $t(39) = -2.78$, $p<.008$, $d=.44$ for female observers and $t(39)=-2.48$, $p<.018$, $d=.45$ for males. Note that while men and women showed comparable rating changes (around .5 on a 9-point scale across conditions), their actual pattern of responses differed: Female observers' significant effects depended on a decrease in ratings when they perceived no interest in the interactions, while the male observers' significant effects arose more from a greater increase in ratings when they perceived interest on the date. Whether observers were single versus in a relationship did not change the magnitude of mate copying they showed, nor did observers' self-perceived attractiveness. Finally it is worth noting that not all participants exhibited any influence of social information—34 of 40 male participants changed their ratings in at least one trial, but only 23 of 40 females.

I next tested how mate copying is influenced by the *relative* attractiveness of the targets and models compared to observers. In particular I were interested in whether observers focus on using social information from models whom they judge as at least as attractive as themselves. Target and model photos were rated for physical attractiveness (1-9 Likert scale) by 3 men and 3 women (ages 19 to 22, Cronbach's $\alpha = .81$). I assessed the observers' sensitivity to social information by looking for *any* changes they make in their pre-test to post-test ratings of target relationship desirability, not just mate copying (positive changes). For each sex of the observers, I ran four multilevel modeling analyses (short-term or long-term rating changes predicted by either self-target or self-model attractiveness differences), with 8 stimulus videos (level 1) nested in 40 observers (level 2) and both predictors centered at their grand-mean level across all participants. For male observers, there were significant effects of self-target attractiveness differences on short-

term and long-term rating changes of target attraction, standardized β=-.22, $p<.001$, and β=-.14, $p< .013$ respectively; the self-model attractiveness difference also significantly affected changes in long-term target attraction, β=-.14, $p= .045$. Thus, as the difference between the (self-perceived) attractiveness of the male observer and that of the target or model increased (i.e., the observer thought he was more attractive than the people he was observing), his changes in relationship-interest ratings generally decreased. This negative beta weight is also consistent with a male observer showing greater mate copying of individuals whose attractiveness approaches or surpasses his own. For female observers, none of the beta weights were significant, indicating little effect of self-other attractiveness comparison (possibly because of women's lower rate of making *any* change in ratings, as mentioned above). Finally, I tested the direct effects of *absolute* target and model attractiveness on actual mate copying, and found only that men copied attractive (male) models more, similar to what Waynforth (2007) found for women.

Discussion

I found that naturalistic stimuli of human romantic interest—videos of speed-dating interactions between real singles—led to robust mate copying effects, producing behavioral patterns not seen in previous studies. While some past research has shown mate copying only in women (Jones, et al., 2007) and primarily for long-term relationships (Little, et al., 2008), my results suggest that both men and women are influenced by social information when making both short-term and long-term relationship attractiveness judgments. The strength of the mate copying effect was found to be similar

in men and women, but the pattern of rating changes producing the effect differed: Men showed an increase in relationship interest in all conditions, whereas women exhibited a decrease after seeing a date where the individuals were not interested in each other and an increase only if the individuals were mutually interested. This pattern could be a manifestation of more general sex differences in mate choice, with women being more picky and less sexually available to all potential suitors (Grammer, Kruck, Juette, & Fink, 2000; Trivers, 1972), possibly also pointing to women's use of a quality assessment heuristic that takes negative model interest as evidence of lower male target quality (Vakirtzis & Roberts, 2009).

I also found that male observers were more likely to change their relationship ratings when viewing attractive models, and models (and targets) whose attractiveness approached or surpassed their own. This suggests that men are also more likely to mate copy models not only who are attractive, but also who they see as being relatively more attractive than themselves. Since self-perceptions of mate value and attractiveness relate to the amount of prior mating success in men (Penke & Asendorpf, 2008, Study 1), this corresponds to Waynforth's (2007) conclusions that mate copying is used more by sexually inexperienced individuals (and to similar findings in animals: Dugatkin & Godin, 1993).

The increase in mating interest that occurs with mate copying is only one possible use of social information regarding the romantic interests of others (Westneat, Walters, McCarthy, Hatch, & Hein, 2000)—the opposite effect of decreased interest is possible as well. Previous studies have found male competition effects, where interest from model females towards a target male decreased observer males' attractiveness ratings of him

(Jones, et al., 2007). I did not test for same-sex effects, but found only increased relationship interest from male observers making opposite-sex ratings (cf. Figure 5-1). Whether this was because my design (asking about interest in having relationships rather than explicit decisions to pursue a target as a mate, as well as the participants only observing instead of directly interacting with the target and model) did not include sufficient cues to elicit feelings of competition on the part of the male participants, or because the costs of male competition are outweighed by the benefits of more attractive mates, must be assessed by further studies.

The use of naturalistic stimuli in my experiment also presented new challenges that require further investigation. Due to the rich information content in the video presentations I employed, it is difficult to ascertain the most important sources of the observer's change in interest in a target. This change could stem from the behavior of the model or the target—that is, the observation of the interest shown by another person of the observer's sex, or the flirtatious response seen from the potential partner—or both. To determine what combination of social (model) and direct (target) information is driving the overall change in interest toward the target, further experiments using videos showing only the targets or the models are underway, similar to control studies with other species (e.g. White & Galef, 1999, 2000a, 2000b). Additionally, the presentation of male/female pairs of daters does not allow us to tell whether there could be similar social-influence effects caused by models of the same sex as the target—that is, if a man watches two women interact in a positive manner, does that make either (or both) of the women more attractive? This possibility awaits testing (but see Hill & Buss, 2008 for group influences on individual desirability), though I expect that any such generalized interest effect

should be smaller than the functional use of mate-relevant interest shown by models of the opposite sex to the target.

Inspired by naturalistic studies of mate copying in animals, I have used naturalistic presentations of romantic interest in humans to show mate copying effects for both men and women, for short-term and long-term relationship judgments, influenced (for men at least) by the relative and absolute attractiveness of models and targets. By paying attention to the mating success of others, humans, like other animals, appear to skew their preferences toward those partners deemed desirable by (some of) their peers.

References:

Alonzo, S. H. (2008). Female mate choice copying affects sexual selection in wild populations of the ocellated wrasse. *Animal Behaviour, 75*(5), 1715-1723.

Biesanz, J., West, S., & Millevoi, A. (2007). What do you learn about someone over time? The relationship between length of acquaintance and consensus and self-other agreement in judgments of personality. *Journal of Personality and Social Psychology, 92*(1), 119.

Borkenau, P., Mauer, N., Riemann, R., Spinath, F., & Angleitner, A. (2004). Thin slices of behavior as cues of personality and intelligence. *Journal of Personality and Social Psychology, 86*, 599-614.

Brown, G. R., & Fawcett, T. W. (2005). Sexual selection: copycat mating in birds. *Current Biology, 15*(16), R626-R628.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204-232.

Dubois, F. (2007). Mate choice copying in monogamous species: should females use public information to choose extrapair mates? *Animal Behaviour, 74*(6), 1785-1793.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Dugatkin, L. A. (2000). *The imitation factor : Evolution beyond the gene*. New York: Free Press.

Dugatkin, L. A., & Godin, J.-G. J. (1993). Female mate copying in the guppy (Poecilia reticulata): age-dependent effects. *Behavioral Ecology, 4*(4), 289-292.

Eva, K. W., & Wood, T. J. (2006). Are all the taken men good? An indirect examination of mate-choice copying in humans. *Canadian Medical Association Journal, 175*(12), 1573-1574.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Freed-Brown, G., & White, D. J. (2009). Acoustic mate copying: female cowbirds attend to other females' vocalizations to modify their song preferences. *Proceedings of the Royal Society B: Biological Sciences, 276*(1671), 3319-3325.

Frommen, J., Rahn, A., Schroth, S., Waltschyk, N., & Bakker, T. (2008). Mate-choice copying when both sexes face high costs of reproduction. *Evolutionary Ecology*.

Funder, D., & Colvin, C. (1988). Friends and strangers: Acquaintanceship, agreement, and the accuracy of personality judgment. *Journal of Personality and Social Psychology, 55*(1), 149-158.

Galef, B. G. (2008). Social influences on the mate choices of male and female japanese quail. *Comparative Cognition & Behavior Reviews, 3*, 1-12.

Galef, B. G., & White, D. J. (1998). Mate-choice copying in Japanese quail,Coturnix coturnix japonica. *Animal Behaviour, 55*(3), 545-552.

Grammer, K., Kruck, K., Juette, A., & Fink, B. (2000). Non-verbal behavior as courtship signals: the role of control and choice in selecting partners. *Evolution and Human Behavior, 21*(6), 371-390.

Hill, S. E., & Buss, D. M. (2008). The mere presence of opposite-sex others on judgments of sexual and romantic desirability: opposite effects for men and women. *Personality & Social Psychology Bulletin, 34*(5), 635-647.

Hill, S. E., & Ryan, M. (2006). The role of model female quality in the mate choice copying behaviour of sailfin mollies. *Biology Letters, 2*(2), 203-205.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Kraus, M., & Keltner, D. (2009). Signs of socioeconomic status: A thin-slicing approach. *Psychological Science, 20*(1), 99–106.

Little, A., Burriss, R. P., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2008). Social influence in human face preference: men and women are influenced more for long-term than short-term attractiveness decisions. *Evolution and Human Behavior, 29*(2), 140-146.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 1113-1135.

Penke, L., Todd, P. M., Lenton, A. P., & Fasolo, B. (2007). How self-assessments can guide human mating decisions *Mating intelligence: Sex, relationships, and the mind's reproductive system* (pp. 37-75). Mahwah, NJ: Lawrence Erlbaum.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Schmitt, D., & Buss, D. (2001). Human mate poaching: Tactics and temptations for infiltrating existing mateships. *Journal of Personality and Social Psychology, 80*(6), 894-917.

Todd, P. M., & Miller, G. F. (1999). From pride and prejudice to persuasion: Realistic heuristics for mate search. In G. Gigerenzer, P. M. Todd & t. A. R. Group (Eds.), *Simple heuristics that make us smart*. New York: Oxford University Press.

Todd, P. M., Penke, L., Fasolo, B., & Lenton, A. P. (2007). Different cognitive processes underlie human mate choices and mate preferences. *Proceedings of the National Academy of Sciences, 104*(38), 15011-15016.

Trivers, R. L. (1972). Parental investment and sexual selection. In C. B. (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Chicago, IL: Aldine-Atherton.

Uller, T. (2003). Human mate choice and the wedding ring effect - Are married men more attractive? *Human Nature, 14*(3), 267-276.

Vakirtzis, A., & Roberts, S. (2009). Mate choice copying and mate quality bias: different processes, different species. *Behavioral Ecology, 20*(4), 908.

Vukomanovic, J., & Rodd, F. (2007). Size-Dependent Female Mate Copying in the Guppy (Poecilia reticulata): Large Females are Role Models but Small Ones are not. *Ethology, 113*(6), 579-586.

Waynforth, D. (2007). Mate choice copying in humans. *Human Nature, 18*(3), 264-271.

Westneat, D. F., Walters, A., McCarthy, T. M., Hatch, M. I., & Hein, W. K. (2000). Alternative mechanisms of nonindependent mate choice. *Animal Behaviour, 59*(3), 467-476.

White, D. J., & Galef, B. G. (1999). Mate choice copying and conspecific cueing in Japanese quail, Coturnix coturnix japonica. *Animal Behaviour, 57*, 465-473.

White, D. J., & Galef, B. G. (2000a). `Culture' in quail: social influences on mate choices of female Coturnix japonica. *Animal Behaviour, 59*(5), 975-979.

White, D. J., & Galef, B. G. (2000b). Differences between the sexes in direction and duration of response to seeing a potential sex partner mate with another. *Animal Behaviour, 59*(6), 1235-1240.

Witte, K., & Godin, J.-G. J. (in press). Mate choice copying and mate quality bias: are they different processes? *Behavioral Ecology*.

Chapter 6

Changes in information quality and observer confidence affect social information usage during mate choice in humans

Preface

In chapter five I presented a new ecologically rational and externally valid methodology for studying mate choice copying in humans. In chapter six, I expand this methodology to answer several new questions. My previous results demonstrated that both men and women utilize the mate copying strategy for both short-term and long-term mates. Here I look at how individuals of different ages, and in different types of relationships utilize mate copying. I am able to uncover if a single man uses social information in the same way as a married woman. Furthermore, I look at how the validity of the source information affects its use, by altering the quality of the mate choice displays, and asking observers to report not only the interest on the dates, but their confidence in their perception of that interest. These results show that mate copying is not used in all situations, and that different observers focus on particular aspects of the mate choice displays when making their decisions to mimic the mate choices of others.

Introduction

In mate choice, one must gather information to evaluate the quality of potential mates (Simão & Todd, 2002). Some of these cues have been naturally selected and represent good fitness (Darwin, 1859), while others have been sexually selected and are present to garner attention from suitors (Andersson & Iwasa, 1996; Darwin, 1871). These independent evaluations where every individual appraises these cues on their own is the basis of mate choice in many species (Ryan, Akre, & Kirkpatrick, 2007). However, for

many animals there is intense competition for mates, and being able to evaluate potential mates efficiently becomes an adaptive strategy for success (Wiegmann & Angeloni, 2007). Therefore, in species that operate in social groups, additional non-independent information is available in the selection of others: Who others are choosing is an additional cue to who could be a good mate. Individuals can then base their own mate choice selections not only by their own assessment, but by the assessment of others, a use of social popularity known as mate choice copying (Dugatkin, 1992; Pruett-Jones, 1992). In this phenomenon an observer (or focal individual) copies the selections of a same-sex peer (the model) who is expressing interest in an opposite-sex potential mate (the target). Originally mate choice copying was found in non-monogamous species (Dugatkin, 2000; Galef & White, 1998), where the exchange of already-selected mates did not cause social friction or break social norms. However recent work has shown this effect in socially monogamous species (Doucet, Yezerinac, & Montgomerie, 2004; Swaddle, Cathey, Correll, & Hodkinson, 2005), including humans (Hill & Buss, 2008; Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Little, Burriss, Jones, DeBruine, & Caldwell, 2008; Place, Todd, Penke, & Asendorpf, in press; Waynforth, 2007; Yorzinski & Platt, 2010).

While mate copying is an established phenomenon in the literature, much is still unknown about how humans are utilizing social information during mate choice. In this study I examine several of the most pressing issues unanswered in the field. First, little is known about when observers choose to mate copy. Research has shown that attractiveness plays a role, as more attractive models have their selections copied more often (Waynforth, 2007; Yorzinski & Platt, 2010), particularly if the model is as least as attractive as the observer views him or herself (Place, et al., in press). However an

important issue in mate copying is knowing when a model is actually interested in a target. Copying models who are presenting disinterest is clearly not a prudent strategy. While humans have been shown to be able to accurately perceive the romantic interest between others (Place, Todd, Penke, & Asendorpf, 2009), most mate copying studies obviate this need, by providing explicit relationship status information about the model and target (Jones, et al., 2007; Little, et al., 2008; Waynforth, 2007; Yorzinski & Platt, 2010). The exception to this is Place et al., who present naturalistic videos of individuals on first-encounter speed-dates, and have the observers decide for themselves if the target and model are interested in each other (2009). The researchers then measure mate copying effects by the change of relationship interest the observer has for the target, based on when the observer thinks the model is interested in the target. However this paradigm does not provide any information on the observers' confidence in their judgments. If it is important to only copy a model who is presenting interest, it is also important to be confident that you are accurate in your judgment of this interest. By asking observers about their confidence in their perceptions, I can better understand how aware observers are about the validity of the information they are viewing, and how this knowledge affects their own interest (and change in interest) in the target mate. In addition to confidence, the strength of the romantic interest perceived could affect observers own interest. Is it better to copy the selection of someone who is somewhat interested in their mate, as compared to very interested? If the validity of the interest cue is an important aspect in mate copying, than I expect observers to copy the most when they are *very confident* that the model is *very interested* in the target.

Another aspect that plays an important role in when to mate copy is the quality of the information that the observer is viewing. All experiments to date have provided equal quantities and quality of information about the target and the model—either as paired photographs (Jones, et al., 2007; Little, et al., 2008; Waynforth, 2007; Yorzinski & Platt, 2010) or video of two individuals interacting (Place, et al., in press). It is unclear if observers would mate copy when limited information is provided about the model, but detailed information is provided about the target. Or vice versa, when model information is scarce, but target information is fruitful, would social information be used in the same manner? I will test this scenario by providing participants with different quantities and qualities of information – by altering the mate choice displays that are used when judging the interest between the target and the model.

A second unanswered question in the mate copying literature is who performs mate copying. While non-human animal research first suggested that mate copying was only utilized by females (Dugatkin, 1992), as females control the mate choice decisions in non-monogamous environments, it is now widely accepted that in environments with mutual choice and high reproductive costs from caring and raising young, both male and female animals (including humans) benefit from utilizing social information (Frommen, Rahn, Schroth, Waltschyk, & Bakker, 2008; Little, et al., 2008; Place, et al., in press). However it is unknown how age and relationship status play a role in mate copying. In guppies, older females will only copy the selection of other older, sexually experienced guppies (Dugatkin & Godin, 1993). In humans, all research has only looked at college-aged participants, thus making it difficult to look for age-based effects. In my study I will have observers from a population wide sample, allowing us to see if humans mimic the

aged-based strategies of the guppies. In addition to age, it is unknown how social information is used by humans with different mate choice goals, especially pertaining to those individuals who are seeking relationships versus extra-marital affairs. In socially monogamous non-human animal species, mate copying is a strategy utilized by females to increase the fitness of the genetic makeup of their offspring, by observing and mating with high-quality males in existing social relationships (Swaddle, et al., 2005). In humans one can imagine that mate copying could be used for either (or both) short-term or long-term relationships (Little, et al., 2008; Place, et al., in press), or by individuals in existing relationships looking for affairs. By using participants who are in a wide range of relationships, from single to engaged and married, I will be able to tell if certain individuals are using mate copying more or less.

To this effect, I present a new study that will strive to answer all of the above stated questions. It will extend from the previous work of Place et al., using naturalistic stimuli of real mate choice interactions (for a discussion of the benefits and drawbacks of using this type of methodology as compared to static controlled pictures, see: Place, et al., in press). It will contain between subject conditions that differ in the type of information presented – either information rich or information poor stimuli concerning the target and the model. Binary yes or no perceived interest responses will be replaced with an interest continuum and a confidence measure, for both model and target interest, allowing a better understanding of the role of observer perceptions of romantic interest within the interaction in their eventual decision to copy a mate choice or not. Furthermore the observers will come from a population level sample, and not from a university subject

pool, allowing analysis across a wide range of ages, relationship statuses, and geographical and cultural locations.

Methods

Participants

Observers comprised 2294 men (mean age 29.6 SD 9.5) and 1917 women (mean age 28.6, SD 9.1) recruited via the internet and compensated with post-experimental feedback on their judgment of interest abilities. All observers were screened to be over 18 and heterosexual. The age distribution was skewed towards younger participants, but all ages were well represented with 62% of the sample being in their 20's, 23% in their 30's and 15% over 40, with similar percentages for both men and women. On relationship status, 52% of the sample self-reported as being single, 22% as dating, 11% as engaged and 15% as married. Geographically, 76% of the sample was located in Europe, 19% in North America, and the rest scattered throughout the world (identified by self-report and confirmed via computer IP addresses).

Stimuli

I used photos of individuals and videos of the same individuals on speed-dates taken from the Berlin Speed Dating Study (BSDS), carefully controlled experimental speed-dating sessions run at Humboldt University in Berlin (for details see: Asendorpf, Penke, & Back, in press; Place, et al., 2009). Speed-dating is designed to allow singles to meet a large number of possible suitors in a short period of time (Finkel, Eastwick, & Matthews, 2007). All BSDS participants were actual singles from the general population

motivated to find a partner. At the end of each three minute speed-date, individuals recorded their interest in seeing the other person again, and after the session mutually interested pairs were given each others' contact information, so they could arrange future meetings. For this experiment, stimuli were created from the interactions of 19 men and 19 women from four different speed-dating sessions. All individuals who appeared in the stimuli gave express permission to have their photos and videos displayed on the internet.

Interactions used in my stimuli were selected to match the overall rates of interest in the dataset, where men made offers 40% of the time, women 30%, and mutual positive matches occurred 10% of the time. Ten dates were used as stimuli (with a different man and woman on each date). The video of each date showed 10 seconds of interaction from the exact middle of each three minute date, as previous research (Place, et al., 2009) demonstrated that this length and location results in higher accuracy for participants' ratings of romantic interest. The videos were framed to capture body language and potential eye contact, and had no sound. Frontal facial photographs of each of the 20 individuals on the 10 dates and an additional 18 daters (9 men and 9 women) from the speed-dating sessions, all smiling, were cropped to reduce cues from clothing, and their size was standardized to identical interpupillary distance.

Procedure

Participants reported their age, gender, sexual orientation and relationship status. Participants then viewed randomly-ordered photos of 19 opposite-sex daters (targets), and made two 1-9 ratings of each: a short-term relationship measure, "How interested would you be in this person as a short-term partner for a brief affair or a one-night-

stand?", and a long-term relationship measure, "How interested would you be in this person as a long-term partner for a committed, exclusive relationship?"

Next participants watched video clips of a subset (10 of the 19) of the just-rated target individuals interacting with a set of opposite-sex individuals (the models) in a succession of speed-dates. There were three between-subject conditions that varied the quality of information presented. Participants either viewed (1) video of both the target and the model, (2) a photo of the target with a video of the model, or (3) video of the target with a photo of the model. Participants made two separate judgments: whether the man was interested in the woman, and whether the woman was interested in the man. Each judgment was rated on a four-point scale: "very not interested / somewhat not interested / somewhat interested / very interested". Additionally participants provided a confidence rating of each of their judgments using a three-point scale: "not confident / somewhat confident / very confident". Following each video or video-photo combination and the subsequent interest judgments, the photo of the target in that clip was presented again, and participants re-rated that individual on the two measures of how interested they would be in a short- or long-term relationship with that person. This process was repeated for all ten interactions. At the end of the experiment participants were told their average judgment accuracy for predicting the men and women's romantic interest.

Results

To look for mate copying effects, I compared the change in ratings of each participant's relationship interest in the photos from pre-test to post-test, based on that participant's *perception* of same-sex (model) interest in the video interactions, averaged across the 10 stimuli sets. In order to first directly compare the results to previous work (Place, et al., in press), the 4-point interest scale was collapsed to a binary no versus yes response. ("very not interested" and "somewhat not interested" were combined to be "no perceived interest", and "very interested" and "somewhat interested" were combined into "perceived interest".) Figure 6-1 illustrates these results for both male and female observers, averaged across all between-subject conditions, for both the short-term and long-term relationship measures. All pairwise comparisons for perceived versus no perceived interest, indicating mate copying, are significant, $t(2294)=-17.70$, $p=.000$, $d=-.43$ and $t(2294)=-16.39$, $p=.000$, $d=-.40$ for male observers' short-term and long-term relationship interest respectively, and $t(1916)=-14.40$, $p= 000$, $d=-.38$ and $t(1916)=-15.51$, $p=.000$, $d=-.40$ for female observers. The strength of the mate copying effect (difference between the pair-wise bars) was not significantly different from the results from the smaller laboratory sample in previous work (Place, et al., in press), for all four cases (male and female observers for short-term and long-term relationship interest).

One issue with using each individual's perception of interest on the dates to look for mate copying effects is that it is introduces biases with projection. If an observer if romantically interested in the target, they might be more likely to think that the model is also interested in the target. In order to combat this control issue, the same analysis was

done using the mean perception as compared to the individual perception of interest on the dates. For each video, the same sex (model) mean perception of interest was calculated, and this variable was used to bin the individual responses into perceived interest versus no perceived interest. All of the main remained strongly significant, for male observer short-term and long-term $t(2294)=-14.82$, $p=.000$, $d=-.35$, and $t(2294)=13.9$, $p=.000$, $d=-0.32$ and for female observers, $t(1916)=-6.68$, $p=.000$, $d=-0.16$ for short-term and $t(1916)=-6.25$, $p=.000$, $d=-0.15$ for long-term.

Besides comparing the strength of the mate copying effect to previous work, I can also look for different strengths within this dataset. Data was separated by sex of observer, and then compared across three age groups (20's, 30's, 40+). Similar mate copying patterns were found in all three age groups for both sexes, with the only exception being short-term relationships for females, $F(2,1918)=4.58$, $p<.01$, $\eta_p^2=.005$ who exhibited a slight decrease in mate copying in the 30's age group. Note that women in their 30's were still mate copying, just that their change in ratings was slightly smaller compared to women in their 20's or over 40. Additionally the data was divided by the relationship status of the observer (single/dating/engaged/married) and analyzed separately for men and women observers. All individuals exhibited mate copying of the same magnitude, for both short-term and long-term relationship interest. This data shows that independent of sex, age or relationship status, observers increase their romantic interest in a target individual if they perceive romantic interest towards that individual from a same-sex model.

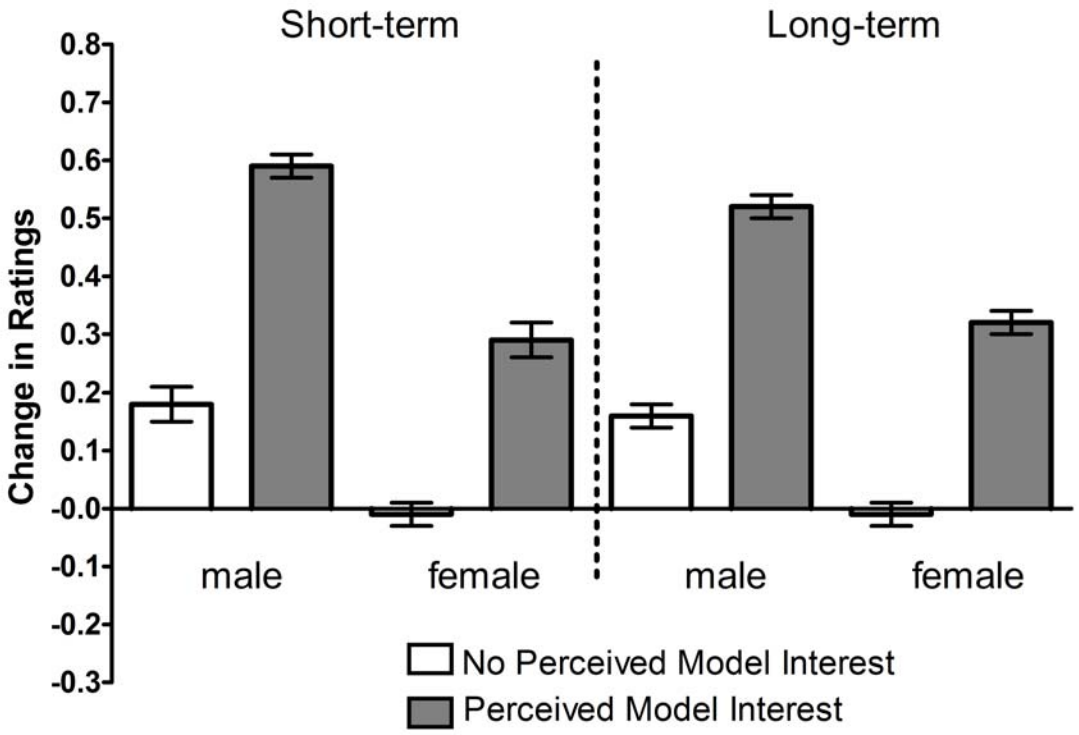


Figure 6-1: Overall mate copying effects for men and women on both short and long-term relationship interest, as seen by the greater increase in relationship interest when the model appeared interested in the target individual than when uninterested (difference between the white and grey bars in each pair). Error bars are +/- 1 S.E.M.

Above I have reported mate copying effects as perceived versus no perceived interest pairwise comparisons. However, the original responses were 4-way measures of perceived interest, and can be utilized to see how the observers' interest in the target changes based on the degree of interest they perceive (between the target and model) in the interaction. I expected to see a continuous upward trend in relationship rating changes as perceived model interest increases. In addition to the degree of interest on the date, observers reported their confidence in their interest judgments. This combination of 4-

way perceived interest by 2-way confidence (not very confident vs. very confident) is shown for long-term relationship ratings in Figure 6-2 (for simplification, the middle "somewhat confident" rating is not displayed). There is a significant increase in the rating changes as perceived interest increases for both men and women observers when they are very confident in their judgments, $F(3,4731)=73.42$, $p=.000$, $\eta_p^2=.044$ and $F(3,1494)=32.23$, $p=.000$, $\eta_p^2=.061$ respectively. There were no significant changes across perceptions of interest when observers had low confidence in their judgments, for either men or women for long-term relationships. The same pattern of results is seen for short-term relationship ratings. This pattern is not simply a manifestation of participants always being very confident in their perception of very interested models, as only weak correlations were present between perceived interest and rating confidence, $r=.12$ for male interest and $r=-.18$ for female interest.

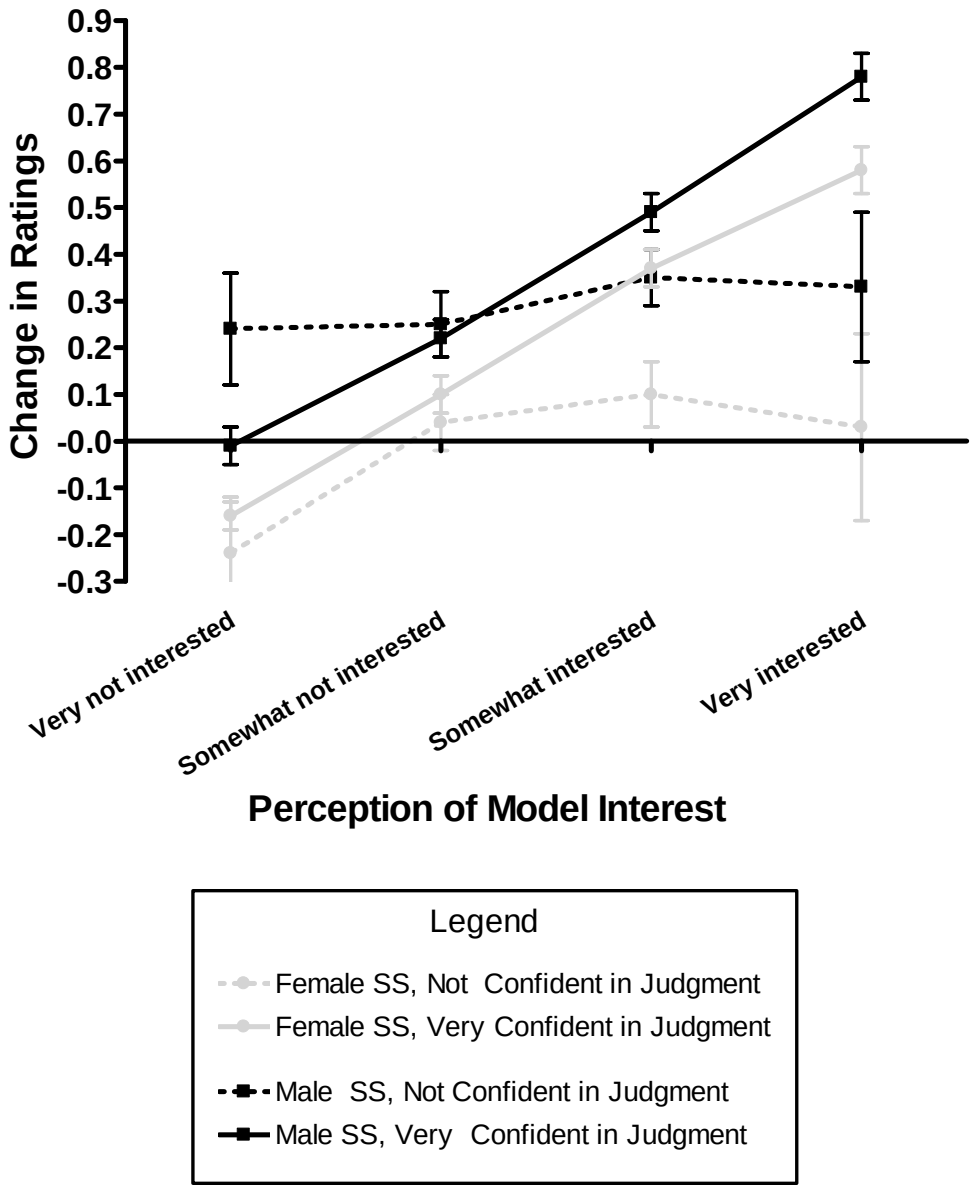


Figure 6-2 - The change in ratings for observers' interest in a long-term relationship with the opposite sex individual on the date, based on the observers' perception of the same-sex dater's interest in their partner and the observers' confidence in this perception. Error bars are +/- 1 S.E.M.

In addition to looking at how individual differences between the subjects affects mate copying, and patterns of results based on confidence and perceived interest, I can compare results across the three between subject conditions, that each present different quantities of information about the daters. The conditions differed in the presentation of the dates: some observers saw video of the man and video of the woman interacting, some saw video of the (same-sex) model and a picture of the (opposite-sex) target, and some saw a picture of the model and video of the target. For male observers, a between-subject one-level ANOVA showed no significant differences in the strength of the mate copying effect between the three conditions (male observers showed mate copying in all conditions). For female observers, there was a significant effect, $F(2,1918)=19.59$, $p=.000$, driven by a reduction in the mate copying effect for the condition when female observers saw video of the female (same-sex model) and only a picture of the man (target) on the date.

In order to delve further into this effect of information presentation on mate copying, the data was divided not only by the perception of model interest, but also by the perception of target interest. It is then possible to compare instances when the observer perceived model interest and either no target interest or target interest, to see how the perception of target interest affects mate copying. This was done separately for each of the three between-subject conditions, to look at how information quality and perceived interest interact. Figures 6-3 and 6-4 present these results for male and female observers respectively, presenting only the data for changes in ratings of short-term relationship interest in the target (results were identical for long-term relationship interest). The four bars (within each condition grouping) represent the 4 possible

combinations of model and target interest, ranging from the leftmost white bar (no model interest & no target interest) to the rightmost grey bar (perceived model interest & perceived target interest). Table 1 shows the significance of the comparisons between the effects, after correcting for multiple comparisons (α=.016) and excluding individuals who did not have data in all four bars (effectively missing data).

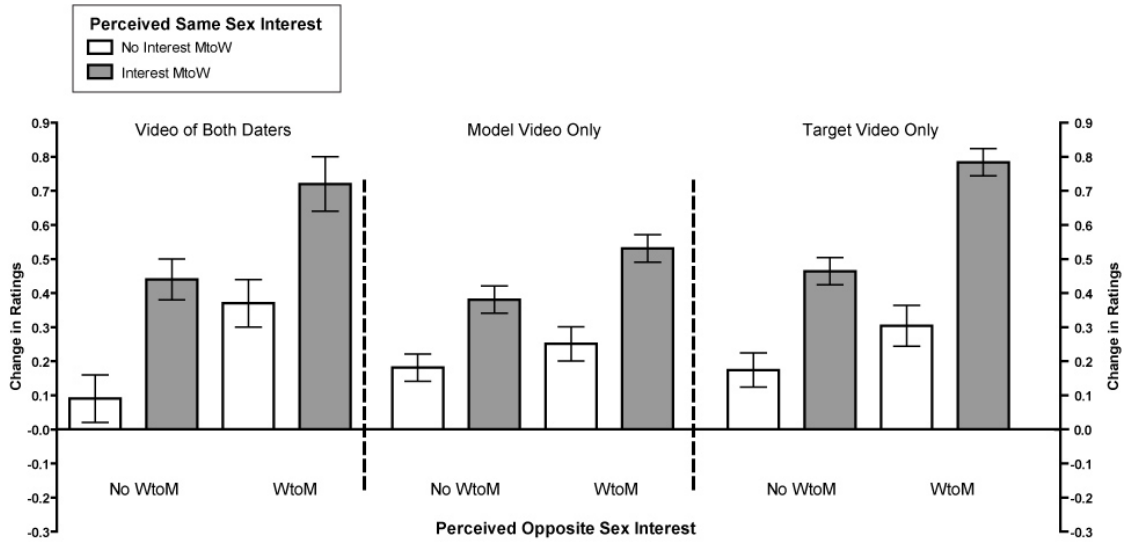


Figure 6-3: Changes in male observers' rating of short-term relationship interest in the target, based on their perception of both model interest and target interest. Each group of four bars represents one between subject condition which differ on the stimuli type presented. In each group, the bars left to right represent: (1) no target interest no model interest, (2) no target interest model interest, (3) target interest no model interest, and (4) target interest model interest. All interest measures are based on the perceptions of the observer, not actual reported interest by the daters. Error bars are +/- 1 S.E.M. Significance effects for this data are presented in Table 1.

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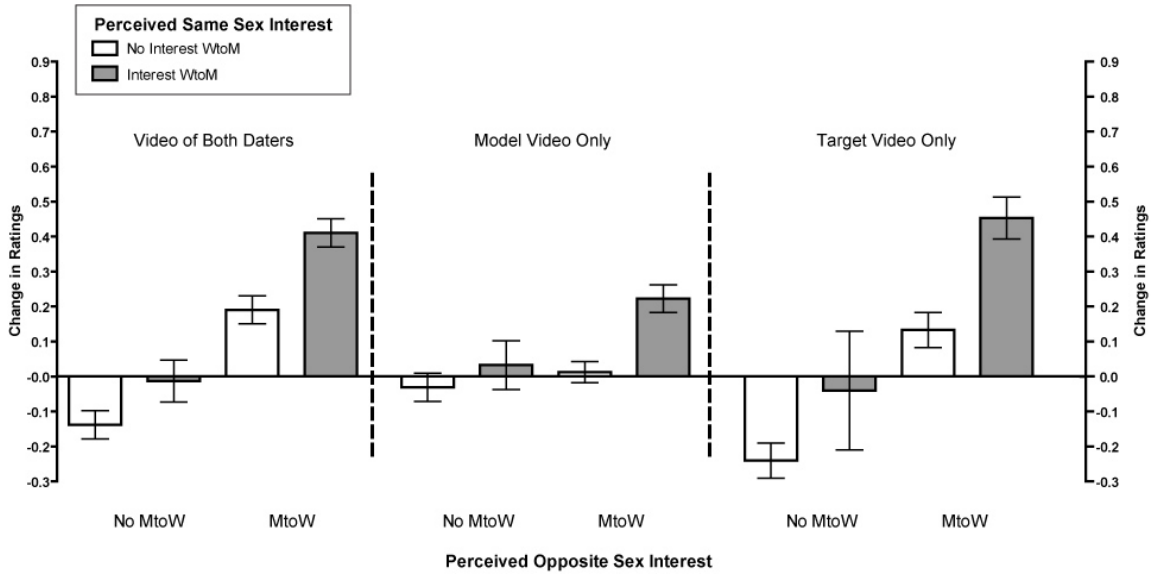

Figure 6-4: Changes in female observers' rating of short-term relationship interest in the target, based on their perception of both model interest and target interest. Each group of four bars represents one between subject condition which differ on the stimuli type presented. In each group, the bars left to right represent: (1) no target interest no model interest, (2) no target interest model interest, (3) target interest no model interest, and (4) target interest model interest. All interest measures are based on the perceptions of the observer, not actual reported interest by the daters. Error bars are +/- 1 S.E.M. Significance effects for this data are presented in Table 1.

While the effects vary between male and female observers, the pattern of increasing relationship interest (indicated by increasing rating changes) as the total perceived interest in the interaction increases is present for both observing sexes. There is an additive effect, whereas the perception of either target or model interest is always less

than the combination of both target and model interest. For male observers, the presence of either model or target interest has an equal effect on the observers' romantic interest in the target, whereas for female observers, the presence of model interest alone is not strong enough to generate an increase in relationship interest. There is also a sex difference in the presentation of information. For male observers, they show an increase in relationship interest in all cases – independent of the type of information available. With only a picture of the target or model, they exhibit the same effects as when seeing naturalistic video interactions of both the target and model. This implies that males require only limited information, and can utilize cues from different sources when making their appraisals. Female observers exhibit a different pattern of results, whereas they exhibit almost no change in ratings when presented with video of only the same-sex model and a picture of the target. Women appear to need more information about the man in question before they will copy the selections of their peers, as they exhibit a strong increase in ratings when presented with either just target video or target and model video.

Male Obs: Short-term, video of both daters, comparing bars:	
1 to 2 (2 bigger)	$t(693) = -5.63$, $p = .000$
2 to 3	not significant
3 to 4 (4 bigger)	$t(627) = -5.29$, $p = .000$
Male Obs: Short-term, video of model only, comparing bars:	
1 to 2 (2 bigger)	$t(624) = -3.37$, $p = .001$
2 to 3	not significant
3 to 4 (4 bigger)	$t(515) = -3.12$, $p = .000$
Male Obs: Short-term, video of target only, comparing bars:	
1 to 2 (2 bigger)	$t(657) = -5.29$, $p = .001$
2 to 3	not significant
3 to 4 (4 bigger)	$t(480) = -6.36$, $p = .000$
Female Obs: Short-term, video of both daters, comparing bars:	
1 to 2 (2 bigger)	$t(456) = -2.72$, $p = .007$
2 to 3 (3 bigger)	$t(472) = -2.96$, $p = .003$
3 to 4 (4 bigger)	$t(634) = -5.10$, $p = .000$
Female Obs: Short-term, video of model only, comparing bars:	
1 to 2 (2 bigger)	$t(369) = -2.76$, $p = .006$
2 to 3	not significant
3 to 4 (4 bigger)	$t(544) = -5.80$, $p = .000$
Female Obs: Short-term, video of target only, comparing bars:	
1 to 2	not significant
2 to 3	not significant
3 to 4 (4 bigger)	$t(595) = -5.42$, $p = .000$

Table 1: significance of pair-wise comparisons of relationship rating changes based on differences in perceived interest, as presented in Figure 6-3 for male participants and Figure 6-4 for female participants. All comparisons are for short-term relationship

interest in the target, patterns of significance were identical for long-term relationship interest.

Discussion

Using realistic stimuli of mate choice interactions, and a large and varied sample of online observers, I found mate choice copying effects of the same sort as previously found in a smaller laboratory run sample (Place, et al., in press), namely that both men and women exhibit mate copying for both short and long-term relationships. However this use of social information does not happen in all instances, as both observer confidence in their perception of dating success and the type of information they've viewed affect the rates of mate copying. For mate copying to be an effective mate choice strategy, observers have to know when they are witnessing a successful mate choice interaction versus a failure, as copying the selection of a model who is actually not interested in their partner is not a prudent strategy. It would follow then that observers should not copy individuals whom they are uncertain are presenting either interest or disinterest. This is exactly what I found, as cases of low confidence in perceptions of romantic interest led to no changes in observers' own interest in the target. Social information was ignored when it was considered of low validity. This pattern existed for both the male and female observers in the sample. An additional change in social information use was exhibited by just the women when the type and quality of information about the target and models changed. When female observers viewed pictures of the opposite-sex target daters, and video of the same-sex model daters, they

showed no increase in relationship interest in the target unless they thought both the model and the target were interested in each other. There are several explanations for this behavior. First, women and men have different risks associated with mate choice (Trivers, 1972), and a great body of literature exists showing that women are more picky and discriminating when choosing mates (Grammer, Kruck, Juette, & Fink, 2000; Kirkpatrick, 1982; Kokko, Brooks, Jennions, & Morley, 2003; Kondrashov, 1988). Furthermore, women have been shown to be harder to read, as they mask their intentions and present ambiguous behavior on dates (Grammer, et al., 2000; Place, et al., 2009). The female observers, when presented with video of just the female models and have limited information about the target must rely on the cues coming solely from the woman on the date, which they might realize are less reliable than feedback cues coming from her male companion. Recent findings have shown that when being asked to predict female interest in romantic encounters, observers are much better at this task if they are shown only the male on the date than only the female on the date (Long, Place, Todd, Penke, & Asendorpf, in prep). The feedback and conversational cues coming from the man are actually more informative than the deceptive cues presented by the female herself. Therefore, even when mate copying is based on the perception of model interest, having more information about the target can actually make this perception more accurate. If female observers are aware of this, either consciously or unconsciously, this could explain their hesitance to mate copy models in these cases.

Male observers do not show this effect when presented only with rich target information (the equivalent case of viewing videos of just women), due perhaps to their focus on female attractiveness, or their willingness to show interest more broadly.

Additionally they could be relying on multiple strategies simultaneously to decide their own interest level in the target. In Figure 6-3, the middle two bars in each condition, showing either model interest and no target interest or no model interest and target interest are roughly the same size, implying that men are attending (and influenced by) social and directly gathered target information. When both cases of perceived interest are present, the effects are additive to form the greatest increase in romantic interest in the target. These effects are independent of the information source – males show the same pattern when information about the target or model is either rich or poor.

While observers changed their pattern of social information usage dependent on their confidence and the sources of information, surprisingly they did not exhibit changes in behavior based on their age or relationship status. In all cases, regardless of observer age, the stimuli were of individuals in their 20's. Mate copying work in guppies has shown that older females will only copy the decisions of sexually experienced older females, and will not show interest in the men being courted by younger inexperienced females (Dugatkin & Godin, 1993). However I do not know if the patterns would be different if older individuals were presented with stimuli of other older individuals. Future work is needed to compare mate copying rates based on the age of the targets and models in relation to the age of the observers. Additionally, observers in different types of relationships showed no differences in mate copying. This begs the question of whether someone who was engaged or married viewed the interaction in the same way as someone who is single or dating. Work in the socially monogamous zebra finch species has shown that these birds do use a mate copying strategy, but only when they are looking for extra-pair copulation (Swaddle, et al., 2005). The coupled females monitor

the nest building and activities of other coupled males, and when their respective partners have left the area the attached females court and mate with these previously selected males. They appear to be attempting to optimize the genetic makeup of their offspring, by finding the best possible male to mate with, even after having socially paired with a male to build a nest and raise their young. While I make no claims that my nearly 1100 engaged or married participants are all using mate copying to search for the ideal mates with whom to have offspring, it does beg the question of how and when mate copying is used by humans. Very little evidence exists on extra-pair copulation rates in humans, however as a theoretical construct it has been thoroughly investigated (Allen & Baucom, 2004, 2006; Greiling & Buss, 2000; Seal, Agostinelli, & Hannett, 1994; Shackelford & Goetz, 2007). However no research has looked at the influences of social information on extramarital relationships, and if strategies like mate copying are more prevalent in these situations than in initial romantic encounters with single observers. More work is needed to uncover when humans are utilizing mate copying in real environments—research that must be done carefully and with great consideration to the risks associated with uncovering infidelity and the paternity of father figures in existing relationships and families.

Overall, these results show that mate copying is a wide spread phenomenon across ages, cultures and relationship statuses. Mate copying is used only when the social information is of high enough validity, and in conjunction with other strategies to ascertain the value of target mates. By using naturalistic video presentations of real mate choice interactions paired with a large internet sample, I am able to get a better grasp of

how individuals could be behaving outside of the laboratory, and understand the role of social information in the evaluation of potential mates.

References:

Allen, E., & Baucom, D. (2004). Adult Attachment and Patterns of Extradyadic Involvement. *Family Process, 43*(4), 467-488.

Allen, E., & Baucom, D. (2006). Dating, Marital, and Hypothetical Extradyadic Involvements: How Do They Compare? *Journal of Sex Research, 43*(4), 307.

Andersson, M. B., & Iwasa, Y. (1996). Sexual selection. *Trends in Ecology & Evolution, 11*(2), 53-58.

Asendorpf, J. B., Penke, L., & Back, M. (in press). From dating to mating and relating: Predictors of initial and long-term outcomes of speed-dating in a community sample. *European Journal of Personality*.

Darwin, C. (1859). *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*: Signet Classic.

Darwin, C. (1871). *The descent of man and selection in relation to sex*.

Doucet, S. M., Yezerinac, S. M., & Montgomerie, R. (2004). Do female zebra finches (Taeniopygia guttata) copy each others mate preferences? *Canadian Journal of Zoology, 82*, 1-7.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Dugatkin, L. A. (2000). *The imitation factor : Evolution beyond the gene*. New York: Free Press.

Dugatkin, L. A., & Godin, J.-G. J. (1993). Female mate copying in the guppy (Poecilia reticulata): age-dependent effects. *Behavioral Ecology, 4*(4), 289-292.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Frommen, J., Rahn, A., Schroth, S., Waltschyk, N., & Bakker, T. (2008). Mate-choice copying when both sexes face high costs of reproduction. *Evolutionary Ecology, 23*(3).

Galef, B. G., & White, D. J. (1998). Mate-choice copying in Japanese quail,Coturnix coturnix japonica. *Animal Behaviour, 55*(3), 545-552.

Grammer, K., Kruck, K., Juette, A., & Fink, B. (2000). Non-verbal behavior as courtship signals: the role of control and choice in selecting partners. *Evolution and Human Behavior, 21*(6), 371-390.

Greiling, H., & Buss, D. M. (2000). Women's sexual strategies: the hidden dimension of extra-pair mating. *Personality and Individual Differences, 28*(5), 929-963.

Hill, S. E., & Buss, D. M. (2008). The mere presence of opposite-sex others on judgments of sexual and romantic desirability: opposite effects for men and women. *Personality & Social Psychology Bulletin, 34*(5), 635-647.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Kirkpatrick, M. (1982). Sexual selection and the evolution of female choice. *Evolution, 36*(1), 1-12.

Kokko, H., Brooks, R., Jennions, M. D., & Morley, J. (2003). Review Paper. The Evolution of Mate Choice and Mating Biases. *Proceedings: Biological Sciences, 270*(1515), 653-664.

Kondrashov, A. S. (1988). Deleterious mutations as an evolutionary factor. III. Mating preference and some general remarks. *Journal of Theoretical Biology, 131*(4), 487-496.

Little, A., Burriss, R. P., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2008). Social influence in human face preference: men and women are influenced more for long-term than short-term attractiveness decisions. *Evolution and Human Behavior, 29*(2), 140-146.

Long, J. M., Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in prep). Seeing is misperceiving: How different sources of information affect the perception of romantic interest.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in press). Humans show mate copying after observing real mate choices. *Evolution and Human Behavior*.

Pruett-Jones, S. (1992). Independent Versus Nonindependent Mate Choice: Do Females Copy Each Other? *The American Naturalist, 140*(6), 1000-1009.

Ryan, M. J., Akre, K. L., & Kirkpatrick, M. (2007). Mate choice. *Current Biology, 17*(9), R313-R316.

Seal, D., Agostinelli, G., & Hannett, C. (1994). Extradyadic romantic involvement: Moderating effects of sociosexuality and gender. *Sex Roles, 31*(1), 1-22.

Shackelford, T. K., & Goetz, A. T. (2007). Adaptation to Sperm Competition in Humans. *Current Directions in Psychological Science, 16*(1), 47-50.

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive Behavior, 10*(2), 113-136.

Swaddle, J. P., Cathey, M. G., Correll, M., & Hodkinson, B. P. (2005). Socially transmitted mate preferences in a monogamous bird: a non-genetic mechanism of sexual selection. *Proceedings of the Royal Society B: Biological Sciences, 272*(1567), 1053-1058.

Trivers, R. L. (1972). Parental investment and sexual selection. In C. B. (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Chicago, IL: Aldine-Atherton.

Waynforth, D. (2007). Mate choice copying in humans. *Human Nature, 18*(3), 264-271.

Wiegmann, D. D., & Angeloni, L. M. (2007). Mate choice and uncertainty in the decision process. *Journal of Theoretical Biology, 249*(4), 654-666.

Yorzinski, J. L., & Platt, M. L. (2010). Same-Sex Gaze Attraction Influences Mate-Choice Copying in Humans. *PLoS ONE, 5*(2), e9115.

Chapter 7

Trait-based mate copying in humans

Preface

In chapters five and six I presented a new mate copying paradigm that showed how and when individuals will choose to copy the mate choice decisions of others in their social environment. In chapter seven, I differentiate between two kinds of mate copying, individual and trait-based, and delve into the individual differences in observers that could lead to their using one strategy over another. Furthermore I discuss the importance of how relationship interest is presented. Showing increased interest in a potential mate who is receiving interest from a same-sex competitor in a first –date environment is very different than if that interest represents a long-term relationship or marriage. The risks inherent in pursuing a previously selected mate are discussed in the context of what types of individuals would relish or shy away from these costs associated with acting on the influences of social information in mate choice.

Introduction

When searching for a mate, one must evaluate the value of potential suitors. Traditional views on mate choice assume choice independence – where each individual searches and gathers information about each suitor directly (Kondrashov, 1988). Informative cues used to judge mates are often sexually selected, such that characteristics and ornamentations of suitors have evolved specifically to prove their worth as quality mates (Andersson & Iwasa, 1996; Trivers, 1972). In non-human animals these displays range from size disparity between the sexes (typically larger males) to the costly but

attention grabbing extravagant and flamboyant tails of male peacocks to attract females. In humans, males' height, strength and wealth are cues that women have been shown to attend to when choosing mates, and a women's physical beauty and youthfulness play an important role in the selections by men (Buss, 1989; Buss & Schmitt, 1993).

While these individual attributes clearly play a part in mate choice and thereby the evolution of a species, they are not the only cues that are governing mate choice decisions. For species that live in social groups, the assumption of truly independent mate choice is false (Gibson & Höglund, 1992). While an individual is directly gathering information about potential suitors, others are doing likewise, and these peer evaluations can be attended to and influence the selection of mates (Pruett-Jones, 1992) in positive or negative directions (Westneat, Walters, McCarthy, Hatch, & Hein, 2000). One of the most studied social information uses in mate choice is an effect known as mate choice copying (Dugatkin, 1992). Under this approach, an individual will show increased romantic interest in a target mate if same-sex peers (models) also show interest in the target. An individual is effectively "copying" the selection of someone else who has (assumedly) spent the time to gather information directly and evaluate the worth of the potential suitor. This observational short-cut strategy has been shown in a variety of animal species (Dugatkin, 1992; Galef, 2008), including humans (Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Little, Burriss, Jones, DeBruine, & Caldwell, 2008; Place, Todd, Penke, & Asendorpf, in press).

Copying the mate choice selections of others can be a risky endeavor. Courting a potential suitor who others are interested in is likely to result in increased competition and a lower chances of success (Dubois, 2007). Additionally, for socially monogamous

species, including humans, there is potential fall-out from within one's social group—friends don't usually appreciate friends trying to steal their romantic partners (or potential romantic partners). One could imagine that mate copying might be more prevalent in social settings with non-monogamous mating practices, where mate sharing is more prevalent or in situations where peer groups are more diverse, and few same-sex individuals are close social group members, thus alleviating this potential social ostracizing. An alternative explanation for using a copying strategy while preserving close social ties is to gather social popularity information from individuals, but not act directly on that information. Instead of copying and pursuing the exact individual of interest, one could recognize the valuable traits of that individual, and independently pursue a different potential mate who shares those traits (Brooks, 1998). This "trait-based" mate choice copying would allow for efficient use of social information, without the potential damage to social ties and the increased risk of competition from pursuing suitors who are actively being courted by others. It would also allow social information to be applied more generally in mate choice environments, instead of only being applicable to one triadic interaction.

If a species are performing trait-based mate choice copying, an important question becomes what traits an observing individual attends to and generalizes from one interaction to the next. Traits could fall into two broad categories – biological and superficial. Biological traits are cues that are driven by genetics and physical appearances – size, symmetry, and individual characteristics that are a product of specific gene expression, such as hair and eye color. These are items that are written into our DNA, such that an observer would be more likely to pursue suitors that are genetically similar

to the target with peer attention. Of course in humans items such as hair and eye color can be readily changed in modern society, so some biological cues can be replicated superficially. Superficial cues can all be worn and changed more readily. These include fashion and clothing cues, status symbols of wealth, and other materialistic or cultural markings including tattoos and piercings. Experimental work with quail and guppies has shown attention to and copying of individuals who possess either types of traits. White and Galef extended their individual based mate copying paradigm using Japanese quail by superficially coloring the breast feathers of individual males either blue or red (2000). When an observing female saw other females interested in one particular color, the observer would prefer males with that color in the future (given an otherwise equal preference for the males). They replicated this effect with biological markers – some male quail have a natural genetic mutation that changes their breast feather colors (white when otherwise dark). Female quail could be trained to attend to this feature (which otherwise carries no mate value information) by the attention that mutated feathered birds received from other females as compared to typically colored controls. The same phenomenon was found in the socially monogamous zebra finch using the superficial cue of colored leg bands (Swaddle, Cathey, Correll, & Hodkinson, 2005), and in the guppy using the biological cue of body color patterns of male fish (Godin, Herdman, & Dugatkin, 2005).

Humans have been shown to exhibit individual based mate copying, so would we expect them to exhibit trait-based copying as well? The trait based copying found to date in non-human animal species have all occurred in non-monogamous mating environments, where social information can be used abundantly without social

repercussion. In humans, where monogamous courtship can lead to social penalties for stealing mates, trait-based copying would seem to be an even more advantageous strategy. I therefore hypothesize that we will in fact see such effects. In the following experiment, I test for the presence of both individual-based mate copying, as well as (for the first time) trait-based copying using a superficial cue. The experimental paradigm extends from my previous work on mate copying in humans (Place, et al., in press), using realistic ecologically valid video presentations of singles searching for potential mates in a speed-dating environment. The superficial trait that I manipulate is the t-shirt color of the daters. I test to see if observing individuals show greater romantic interest in others wearing the same t-shirt color as an opposite-sex target that the observers perceive has received attention from a same-sex peer.

Assuming that humans do in fact exhibit trait-based mate copying behavior, it is possible that individual differences in observers could dictate their preference for one type of mate copying over the other (or a preference to do neither). There is mixed evidence for individual differences in human mate copying in the current literature. Waynforth's (2007) data on the sexual experience of female observers implies that individuals with less sexual experience, and a more restricted sociosexual orientation — less interest in short-term relationships (Penke & Asendorpf, 2008; Simpson & Gangestad, 1991) — will use mate copying more. Waynforth, (2007) as well as Little, (2008) believe that mate copying is a way to get at intrinsic attributes of a potential dater that are hard to ascertain from a quick glance. Items such as physical attractiveness and clothing / status cues are easy to perceive directly, but it takes time to learn about an individual's sense of humor, personality, and other internal attributes that would be

important in a long-term relationship. They claim, therefore, that mate copying is a way to by-pass the time needed to learn about these attributes through direct interaction, by copying the selections of someone who has (hopefully) spent the time to ascertain the value of these attributes already. Little's data supports this idea: observers show increased interest for long-term relationships (and not short-term) where these intrinsic qualities would be more important.

However, current methodologies have a major confound when trying to ascertain how different kinds of individuals will behave. In both Little and Waynforth's work, couples are labeled as being in a relationship (2008; 2007). It is ambiguous as to how this relationship status in interpreted by the observers: would the targets to be single at a later date, or would the observer have to pry them out of their existing relationships to start a new one with the participant? These differences in the perception of relationship initiation risks could alter how individuals behave, and could introduce significant noise into the samples when trying to ascertain individual differences.

I feel that in fact, the sexually inexperienced individual that Waynforth and Little think would utilize mate copying the most might in fact be more likely to utilize trait-based over individual-based mate copying, and that an entirely different type of person would benefit the most from the individual-based mate copying strategy. An additional individual difference measure that is relevant to this discussion is self-monitoring: the principle that people differ in the level in which they observe and control their behavior and self-presentation. As determined by a 18 question true or false Self-Monitoring Scale (Gangestad & Snyder, 1985; Snyder, 1974), low-self monitors wear their opinions on their sleeve, and their behaviors reflect their attitudes and personalities directly. High

self-monitors are influenced by social pressures and different social scenarios, and alter their self-presentation based on what they think is the most appropriate for the current environment. One can imagine that high self-monitors are the kinds of people that would be influenced by what others think, and would utilize social information in mate choice because of it. Additionally, the self-monitoring scale has been linked to the sociosexual orientation index, and high self-monitors have high (unrestricted) SOI ratings, and low self-monitors have low (restricted) SOI ratings (Snyder, Simpson, & Gangestad, 1986).

I can now describe two different types of individuals who could be using mate copying. Low SOI, low self-monitors, utilize the choices of others who perhaps have more sexual experience than they do, in order to gain information about target individuals that they cannot readily pick up from observation. They use this information to look for traits across individuals that would be important in long term relationships. They are not primarily interested in physical attractiveness, nor are they willing to risk "stealing" a mate from someone, so instead they look for similarities across individuals and choose mates that are most likely not being courted by many others.

On the other hand is the high SOI, high self-monitor. They are also sexually experienced and focus on physical attractiveness and short term relationships. They care deeply about what other people think and how they are viewed in their social groups. They utilize mate copying to go after popular individuals who are already garnering attention from many others. By choosing these popular targets, they get attention from their social group, as well as the validation of potentially succeeding where others have failed (getting a popular mate). While these two descriptions are obviously stereotyped to the extreme individual characteristics that would make up each persona, they present the

idea that different types of individuals could be using the same choice copying technique in different ways.

To test for these individual differences, I will have my participants complete a series of relevant measures: the revised SOI scale (Penke & Asendorpf, 2008), the Self – Monitoring Scale (Snyder, 1974), the Self-Assessed Mate Value Scale (Landolt, Lalumiere, & Quinsey, 1995), as well are reporting their relationship and sexual history.

Methods

Subjects

The study included 120 participants, 74 women (mean age: 19.0) and 46 men (mean age: 19.8). Participants were recruited from the Indiana University psychology subject pool and were compensated with research credits required for undergraduate coursework. Participants were screened to be over 18 years old, heterosexual, and with no knowledge of the German language (because the stimuli were in German; see next section). Informed consent was received from each participant before the start of the experiment.

Stimuli

The stimuli used in this experiment consist of photos of individuals, and videos of the same individuals on speed-dates. These stimuli come from the Berlin Speed Dating Study (BSDS) (for details see: Asendorpf, Penke, & Back, in press; Place, Todd, Penke, & Asendorpf, 2009), a set of carefully controlled experimental speed-dating sessions run at Humboldt University in Berlin. Speed dating is designed to allow singles to meet a

large number of possible suitors in a short period of time (Finkel, Eastwick, & Matthews, 2007). In a typical speed-dating session, roughly a dozen men and a dozen women meet in pairs and get to talk for 2 to 5 minutes. At the end of each conversation, individuals record their interest in seeing the other person again, and after the session mutually interested pairs are given each others' contact information, so they can arrange another meeting.

I used photos and videos from the BSDS sessions of singles in their 20's who participated in free speed-dating in exchange for filling out questionnaires and being photographed and videotaped. In this experiment, 15 men and 15 women from 6 different speed-dating sessions were used in the stimuli. Forward facing photographs of each of the 30 individuals were cropped and normalized to be from chest height up and to standardize facial position (all individuals were smiling). Stimuli fell into three separate groups – targets, copies, and controls. Targets were selected on the basis of wearing a unique solid colored shirt. Each of the 5 male and 5 female targets' shirts represented different major color groups. The copies group consisted of 5 male and 5 female pictures that were chosen to have clothing whose color matched one of the same-sex targets. When exact matches could not be procured from the dataset, clothing was copied from the target photo to the copier photo, for a near identical match. Professional photo editing software was used to guarantee a realistic presentation. The control group consisted of 5 males and 5 females whose shirts were of colors that were not used in any of the pictures of individuals in the target group. The end effect was one group of 10 pictures, each featuring individuals wearing different colors (the targets), another group of 10 pictures featuring different daters each matching one of the individuals clothing from the target

group (the copies), and a third group of 10 daters whose shirt colors were unique (controls).

Additionally, videos of each of the individuals in the target group were presented (5 each for male targets and female targets). Each target man was shown on a date with the same woman (another member of the target group), and each target woman was shown with the same man. These were individuals from the same speed-dating session, and thus every member of the session talked with every opposite sex member of the same session. I wanted to present participants with clips that provided the most useful and accurate information regarding the intentions of the daters, so I showed 10 seconds of interaction from the exact middle of each 3-minute date as previous research (Place, et al., 2009) has shown that this length and location results in the higher accuracy for participants' ratings of interest. Two video angles were presented side by side showing each individual on the date. The videos allowed observers to hear what was being said, as well as view body language and eye contact. All conversation on the dates was in German. Across the 10 videos, 5 for male targets and 5 for female targets, both male interest in his date, and female interest in her date was 50%. Couples were mutually interested in each other 20% of the time.

Procedure

Participants first answered a brief survey concerning their age, gender, relationship status and perception of self-attractiveness. Self-attractiveness was measured in two ways: the average of 1-9 Likert ratings of eight questions (Landolt, et al., 1995),

and a single question measure, “How attractive do you think you are?” Additionally, the survey measures above were given to every participant.

Participants next viewed photos of the opposite-sex daters (15 total, from all three groups – ordered randomly), and made two 1-9 ratings of each photo: a short term relationship measure, “How interested would you be in this person as a short-term partner for a brief affair or a one-night-stand?” followed by a long term relationship measure “How interested would you be in this person as a long-term partner for a committed, exclusive relationship?” Next the participants watched 5 video clips, one of each individual in the opposite-sex target group interacting with another person in a speed-date. Video order was randomized. The participants’ task was to judge the interest in each interaction, responding with either “yes” or “no” to two measures of interest, “Do you think the man was interested in / attracted to the woman?” and “Do you think the woman was interested in / attracted to the man?” Following each video, a series of photos of 3 individuals (all rated before) were presented, and participants rerated each individual on the two interest measures given above. First the participants rated a picture of the target they just seen in the movie, followed by that target’s color-matched individual from the copies group. Finally they saw a random (non-repeating) member of the control group. This process was repeated for all 5 opposite-sex members of the target group. This design allows us to compare pre and post-test ratings for each of the 15 opposite sex individuals, based on the perception of the dating success of the daters in the target group, mimicking the basic methodology of my previous mate copying work (Place, et al., in press).

Results

First I looked for the presence of individual-based mate copying. To do this I assessed participant observers' change in their own romantic attraction to the opposite-sex speed dater targets as a consequence of the social information they *perceived* from watching the videos—that is, whether they thought the model was interested in the target. Remember that in this experiment, the model is one same-sex individual – seen on 5 dates with different targets. This was done to reduce noise in the data, as changes in model attractiveness have been shown to influence mate copying effects (Place, et al., in press; Waynforth, 2007). For male observers, there were significant individual-based mate copying effects for both short-term relationship interest, $t(45) = -2.60$, $p<.012$, and long-term relationship interest, $t(45) = -2.00$, $p<.051$. The same pattern of individual based mate copying was present in women observers, $t(73) = -3.25$, $p<.002$ for short-term, and $t(73)= -3.94$, $p<.001$ for long-term.

While the sexes exhibited roughly equivalent behavior for individual-based copying (and similar to previous work: Place, et al., in press), there were dramatic differences for trait-based copying. Male observers exhibited strong trait-based copying effects, for both short-term interest, $t(45)=-2.29$, $p<.026$, and long-term, $t(45)=-2.82$, $p<.007$. Women only exhibited an effect for short-term relationship interest, $t(73)=2.36$, $p<.021$, but in the *opposite* direction. When they perceived the model as being interested in the target, they were *more* interested in the exact target, and *less* interested in another male wearing the same color shirt. For all observers, the control picture exhibited no

effect of perceived interest, for either short-term or long-term. Figure 7-1 presents these findings for male observers, Figure 7-2 for female observers.

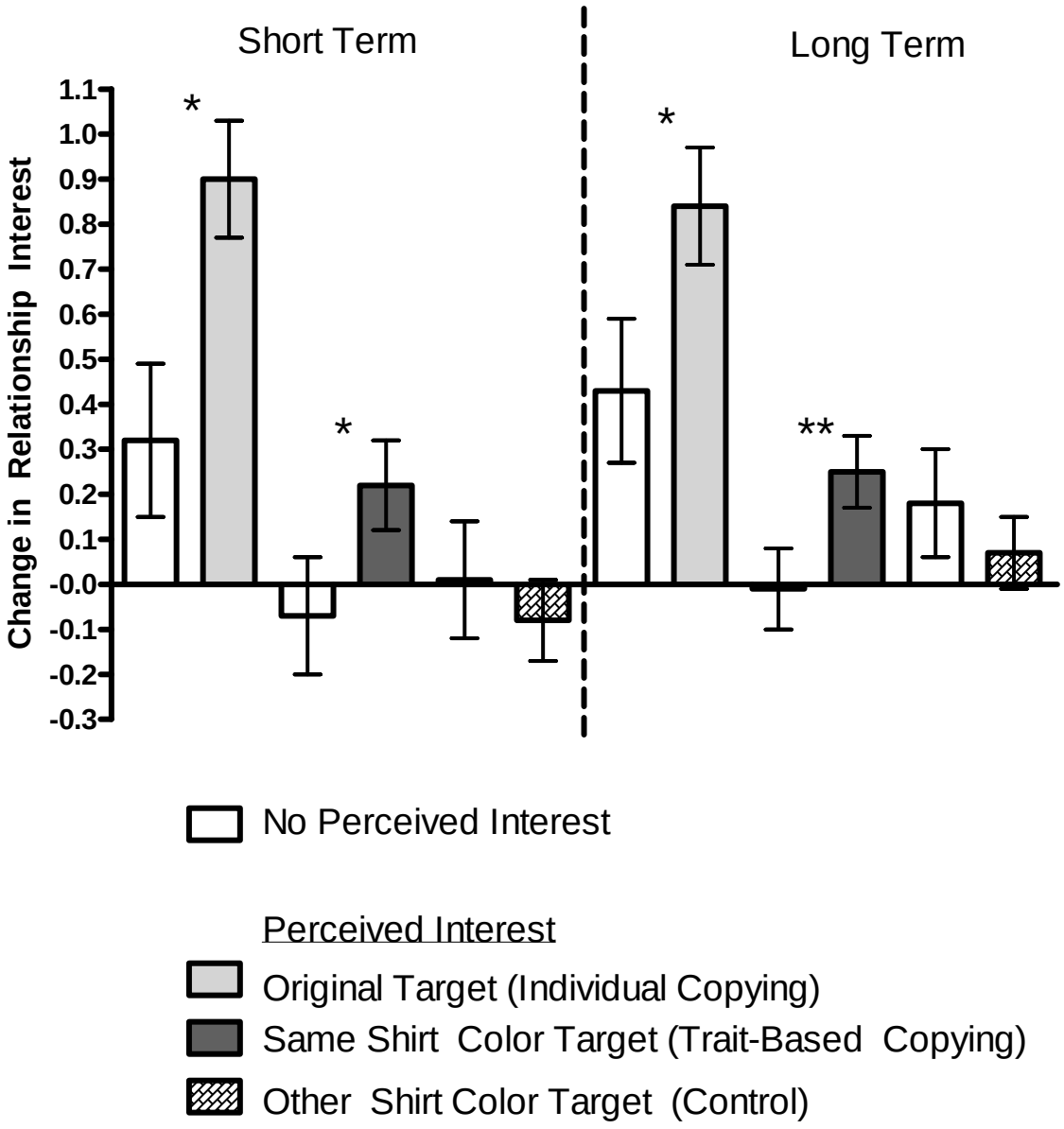

Figure 7-1: Mate copying effects for male observers.

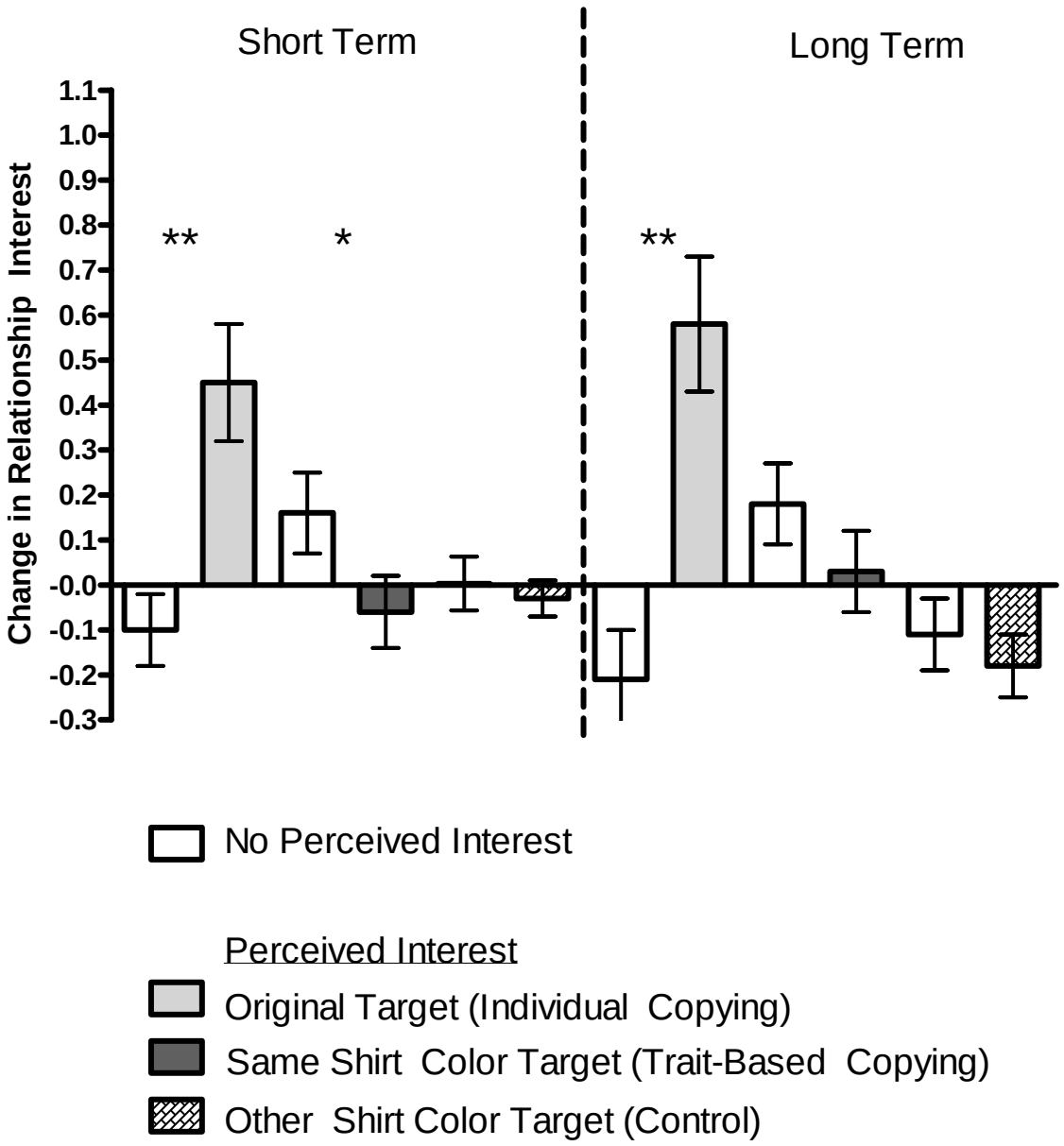

Figure 7-2: Mate copying effects for female observers

In addition to the main effects of individual and trait-based mate copying, there were significant individual differences patterns for the observers. I correlated the rates of copying behavior (individual short-term and long-term and trait-based short-term and

long-term) to each participant's scores on the survey measures. For male participants, there were significant correlations with the Big-Five personality measures as well as the Sociosexual Orientation Inventory and sexual experience. The personality factor of conscientiousness, which measures a tendency for planned vs. spontaneous behavior and our regulation of impulses and behavioral control, correlated negatively with individual mate copying, for short-term $r=-.309, p<.037$, and with trait-based for short-term, $r=-.377$, $p<.01$ and long-term, $r=-.315$, $p < .033$. This negative correlation implies that individuals who exhibit less impulse control are performing more mate copying. Additionally, the behavioral component of the SOI, and the number of lifetime sexual partners correlated negatively with only trait-based long-term relationship interest, $r=-.301$, $p<.042$ and $r=-.34$, $p<.022$ respectively. This component of the SOI measures an individual's history of short-term relationships, and the negative correlation implies that an individual who has a sexual history with few one night stands is most likely to perform trait-based mate copying for long-term relationships. Similarly, an individual who has had more one-night stands is more likely to have a greater number of lifetime sexual partners, so individuals who have had fewer sexual partners also perform more trait-based copying. For male observers, there were no significant correlations involving the self-monitoring scale or self-perceived mate value.

For female observers, there were no significant correlations with any of the individual difference measures. This could be due to the fewer number of female participants who exhibit any change in ratings over the course of the experiment, as compared to their male counterparts. Furthermore, females did not exhibit trait-based behavior in the same fashion as the men.

Discussion

The results for male participants show that observers are performing both individual based mate copying, as well as trait-based copying, for both short-term and long-term relationships. The effect sizes of the individual based copying are similar to my previous mate copying findings (Place, Todd, Penke, & Asendorpf, in prep; Place, et al., in press) using naturalistic stimuli of romantic interest. The trait based results are the first example of a generalized mechanism of social information usage during mate choice – where the observation of romantic interest towards one individual carries over to new potential mates. The superficial cue of clothing color is strong enough to increase romantic interest in other individuals wearing the same color. This mimics the finding in bird and guppy species (albeit those were with female observers instead of male, Godin, et al., 2005; Swaddle, et al., 2005; White & Galef, 2000).

Female observers, however, exhibited a surprisingly different pattern of results. Their individual-based mate copying effects mimicked the males, and previous findings of female observers using similar stimuli (Place, et al., in prep, in press). For trait-based copying, they exhibited a complete reversal in social information usage, a significant effect for short-term relationship interest, and a trending effect for long-term. When perceiving other females as interested in a target male, female observers showed *increased* interest in that *same* male, and *decreased* interest in *different* males who shared t-shirt colors with that original target male. There is no existing human or non-human animal research that exhibits a similar pattern of findings for social information usage in mate choice.

My results also provide preliminary support for my individual differences hypothesis. While I did not find differences in self-monitoring, significant and meaningful patterns did appear for sociosexual orientation and conscientiousness. My belief that individuals who have a low SOI, and limited sexual experience should be using trait-based mate copying for long-term relationships was validated. Furthermore conscientiousness plays a role – as it correlated negatively with three of the four types of mate copying. Perhaps any individual who is motivated by social information exhibits less impulse control that others, as they are being directly influenced by their peers, and are not making their decisions based solely on individually gathered information.

While my data shows individual differences in the current sample, my design suffers from the same methodological problems of previous designs, involving how subjects perceive the relationship status of the observed couple. In the current design described in this paper, observers are told they are watching video clips of initial encounter speed-dating interactions. In other designs, observers are told that the individuals they see in pictures are in committed relationships (Little, et al., 2008; Waynforth, 2007). Differences in mate copying effects and in the types of people who would perform mate copying could arise from perceptions in the risks and competition of pursuing a mate who is either single, but dating (i.e. the speed-daters) vs. a mate who is in a committed relationship. How observers are internalizing these risks and rewards plays an important role in how they would actually act if these situations were happening outside of the laboratory. Recent work has tried to obviate this problem by describing couples as previously in a long-term relationship but now are single (Yorzinski & Platt, 2010). This introduces further complications as it is unclear how the relationship ended,

who broke it off, and for how long the couple has been separated. Further experimentation is needed with careful instructions and follow-up questions that explain and evaluate the actual levels of attachment of the observed couples, and how observers are perceiving and acting on those additional risks and potential competition.

References:

Andersson, M. B., & Iwasa, Y. (1996). Sexual selection. *Trends in Ecology & Evolution, 11*(2), 53-58.

Asendorpf, J. B., Penke, L., & Back, M. (in press). From dating to mating and relating: Predictors of initial and long-term outcomes of speed-dating in a community sample. *European Journal of Personality*.

Brooks, R. (1998). The importance of mate copying and cultural inheritance of mating preferences. *Trends in Ecology & Evolution, 13*(2), 45-46.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*, 1-49.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204-232.

Dubois, F. (2007). Mate choice copying in monogamous species: should females use public information to choose extrapair mates? *Animal Behaviour, 74*(6), 1785-1793.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Galef, B. G. (2008). Social influences on the mate choices of male and female japanese quail. *Comparative Cognition & Behavior Reviews, 3*, 1-12.

Gangestad, S., & Snyder, M. (1985). To carve nature at its joints": On the existence of discrete classes in personality. *Psychological Review, 92*(3), 317-349.

Gibson, R. M., & Höglund, J. (1992). Copying and sexual selection. *Trends in Ecology & Evolution, 7*(7), 229-232.

Godin, J.-G. J., Herdman, E. J. E., & Dugatkin, L. A. (2005). Social influences on female mate choice in the guppy, Poecilia reticulata: generalized and repeatable trait-copying behaviour. *Animal Behaviour, 69*(4), 999-1005.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Kondrashov, A. S. (1988). Deleterious mutations as an evolutionary factor. III. Mating preference and some general remarks. *Journal of Theoretical Biology, 131*(4), 487-496.

Landolt, M. A., Lalumiere, M. L., & Quinsey, V. L. (1995). Sex differences in intra-sex variations in human mating tactics: An evolutionary approach. *Ethology and Sociobiology, 16*(1), 3-23.

Little, A., Burriss, R. P., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2008). Social influence in human face preference: men and women are influenced more for long-term than short-term attractiveness decisions. *Evolution and Human Behavior, 29*(2), 140-146.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 1113-1135.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in prep). Changes in information quality and observer confidence affect social information usage during mate choice in humans.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in press). Humans show mate copying after observing real mate choices. *Evolution and Human Behavior*.

Plath, M., Richter, S., Tiedemann, R., & Schlupp, I. (2008). Male Fish Deceive Competitors about Mating Preferences. *Current Biology, 18*(15), 1138-1141.

Pruett-Jones, S. (1992). Independent Versus Nonindependent Mate Choice: Do Females Copy Each Other? *The American Naturalist, 140*(6), 1000-1009.

Simpson, J., & Gangestad, S. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology, 60*(6), 870-883.

Snyder, M. (1974). Self-monitoring of expressive behavior. *Journal of Personality and Social Psychology, 30*(4), 526-537.

Snyder, M., Simpson, J. A., & Gangestad, S. (1986). Personality and Sexual Relations. *Journal of Personality and Social Psychology, 51*(1), 181-190.

Swaddle, J. P., Cathey, M. G., Correll, M., & Hodkinson, B. P. (2005). Socially transmitted mate preferences in a monogamous bird: a non-genetic mechanism of sexual selection. *Proceedings of the Royal Society B: Biological Sciences, 272*(1567), 1053-1058.

Trivers, R. L. (1972). Parental investment and sexual selection. In C. B. (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Chicago, IL: Aldine-Atherton.

Waynforth, D. (2007). Mate choice copying in humans. *Human Nature, 18*(3), 264-271.

Westneat, D. F., Walters, A., McCarthy, T. M., Hatch, M. I., & Hein, W. K. (2000). Alternative mechanisms of nonindependent mate choice. *Animal Behaviour, 59*(3), 467-476.

White, D. J., & Galef, B. G. (2000). `Culture' in quail: social influences on mate choices of female Coturnix japonica. *Animal Behaviour, 59*(5), 975-979.

Yorzinski, J. L., & Platt, M. L. (2010). Same-Sex Gaze Attraction Influences Mate-Choice Copying in Humans. *PLoS ONE, 5*(2), e9115.

Section 3

Popularity in Mate Choice Networks

In section one I discovered an adaptive mate choice mechanism for observing and judging the romantic interest between others, and uncovered the cues that could drive such perceptions. In section two the affect of these judgments on ones mate choice decisions were analyzed, and a popularity effect known as mate-choice copying was documented in humans. In the behavioral experiments outlined in section two, popularity was defined as an observer's perception of interest by a same-sex peer towards an opposite-sex target mate. Popularity is hardly ever the outcome of a single individuals' opinion however, especially in large dynamic social groups. The combination of interest towards a target mate from many different individuals is more likely an accurate measure of popularity. However popularity can be more complex than just the summation of global interest, if certain individuals (perhaps with higher status) show interest in a target, it can outweigh the greater combined interest by many more individuals. The qualities of the individuals who are presenting interest in a target could play a crucial role in whom, when and how their decisions are copied.

In section three I look at mate choice decisions coming from a fixed environment, by analyzing the decisions made within the speed-dating interactions that have served as the stimuli for the experiments in sections one and two. Different forms of popularity are analyzed, and the individual attributes that make one individual popular under one index are compared to the attributes for other popularity indexes. These varying definitions of popularity allow for a better understanding of what types of social information could play an important role during mate choice, and how the raw number of offers an individual receives might not be the best mechanism for studying their centrality and importance in a mate choice network.

Chapter 8

What drives popularity in mate choice?

Introduction

In mate choice, one must gather information to ascertain the value of potential mates (Simão & Todd, 2002). Traditional views on mate choice are that information comes solely from independent evaluation: Every individual observers and interacts with their own potential mates to assess their mate value (Kondrashov, 1988). These independent selections drive sexual selection, where attributes that are valued by the opposite sex and lead to more mating opportunities get selected over many generations, and become prominent in a species (Andersson & Iwasa, 1996). However, research has shown that non-independent selections can also drive mate choice, and that sexually selected traits are not the only cues being used to evaluate mates (Kirkpatrick & Dugatkin, 1994). These non-independent decisions can stem from viewing the mate choice selections of others, and being influenced by their selections (Dugatkin, 1992). Whom we like then, might be a combination of who we think we like, and who we think others like. This social popularity is framed in the phenomenon of mate choice copying, whereas an observer will show increased romantic interest in a potential mate whom other same-sex competitors are also interested in (Pruett-Jones, 1992).

However, popularity is a vague term that could mean several different things. In most laboratory experiments studying mate choice copying, popularity is mating interest shown by one other individual towards a potential mate (Galef, 2008). In human studies, this interest could be either explicitly labeled (through relationship status) or perceived on the part of the observer (Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Little, Burriss, Jones, DeBruine, & Caldwell, 2008; Place, Todd, Penke, & Asendorpf, in press).

Often in animal studies the presentation of interest is the actual act of mating (Galef & White, 1998). Either way, outside of the laboratory, social interactions and mating observations are rarely limited to a single observer, or a single interaction. Popularity could then be measured not by the binary presentation of interest or lack thereof, but by the summation of interest across the entire local environment. Popularity, however, might not stem from just the raw number of interested parties as some potential suitors could be of very low value, and would never have a chance with the intended target. Therefore, perhaps the quality of the suitors places an important role (Hill & Ryan, 2006; Vakirtzis & Roberts, 2009; Witte & Godin, 2010). Work with mate choice copying in humans has already shown that more attractive individuals have their choices copied more often especially if they are at least as attractive as the observer (Place, et al., in press). Receiving offers from high status suitors could be more important than receiving (and responding to) more suitors overall.

The kind of data that encompasses the selections and observations of a large number of individuals are very difficult to gather from the natural world. Social environments can be very large, and it is often impossible to know if all members have had a chance to interact with each other. The lack of romantic interest could be due to the lack of acquaintance, or actual disinterest after meeting. One environment that alleviates these problems is mate choice decisions in the context of speed-dating. Speed-dating presents a valuable medium in which (for a small population size) every member of the opposite sex interacts with each other, and everyone is on the search for prospective mates (Asendorpf, Penke, & Back, in press; Finkel & Eastwick, 2008).

In this study I will look at data from a large speed-dating sample, and use different approaches to study popularity within the network. For this particular sample, a large number of individual attributes have also been gathered about the daters. This allows us to see if the same traditional sexually selected attributes that govern independent mate choice decisions (Buss, 1989) also influence more complex measures of network importance and centrality. By looking at the differences in actor attributes across these measures, we can better understand which individuals would have a greater influence on non-independent mate choice selections.

Additionally, for this particular dataset, measurements were taken not only of the actual interest between the daters, but also the perception of interest. For every interaction, every dater wrote down if they wanted to see their partner again, and if they thought their partner wanted to see them again. These perceptions of popularity allow for analysis of the self-awareness of network positioning relative to the overall perceptions of interest across all daters. Self-awareness of popularity is important for protecting owns mate choice interests. If an individual is aware that they are a popular member of the group, and that others are keenly watching them and interested in their opinions on who the best mates are, they suffer increased competition from peers. In the Atlantic Molly, male fish who realize other males are watching them court mates will purposely court a lower quality mate, before returning to court their high quality preference when the crowd diminishes (Plath, Richter, Tiedemann, & Schlupp, 2008). By looking at whom an individual believes they are getting offers from, I can compare their perception of their worth to their actual worth, to see if self-perceptions are at all accurate, as would be necessary to protect from these kinds of popularity copying risks.

By treating speed-dating data as a social network, I am able to use novel analyses to mate choice to look at popularity and prestige within a highly controlled, fully-crossed social environment. These findings on the actual and perceived positioning within the network can help us better understand the role individual attributes can play in non-independent mate choice.

Methods

Dataset

The data used in this analysis comes from the Berlin Speed Dating Study (BSDS) a set of carefully controlled speed-dating sessions run at Humboldt University in Berlin (Asendorpf, et al., in press; Place, Todd, Penke, & Asendorpf, 2009). Speed-dating is designed to allow singles to meet a large number of possible suitors in a short period of time (Finkel, Eastwick, & Matthews, 2007). The BSDS was a unique speed-dating experience for several reasons. First, participants completed a wide variety of personal history, sexual history, and personality testing surveys before the start of the dating period. Second, opposite-sex participants were kept entirely separate from each other until their dates. Therefore individuals had no idea whom they would be meeting, and would not be able to get a sense of the range of options available during their session. This allowed for a more pure sequential choice process, as individuals were not aware of more attractive higher quality potential partners existing later in the event. Third, additional measures were recorded during the speed-dating session. Typically, observers are asked to report simply their own interest in their partner. This allows the speed-dating

matching to occur, whereas pairs of individuals who both report interest in their partner receive each other's contact information and are free to meet again. In addition to this measure, each dater was asked to report if they thought their date was interested in them. Therefore daters reported their own actual interest in their date, and their perception of their date's interest in themselves. Fourth, the interactions were video and audio recorded and all daters were photographed before the start of the session.

The dataset consists of 382 individuals, 190 men and 192 women. There were 17 different sessions, ranging in number of participants from 8 men and 8 women to 12 men and 14 women. Each session contained daters from a specific age range: a 20's group, a 30's group, and a 40's group. There were 6 sessions in the 20's age range, 7 in the 30's and 4 in the 40's.

Actor Attributes

From the complete set of survey measures a subset were chosen for use in this analysis. Gender, age, and education level were included as basic mate value attributes. So were measures of sexual and relationship experience, through two questions, the number of lifetime sexual partners, and the amount of time spent in serious relationships. Personality was measured through the Big-5 scale, which breaks personality into five separate variables: neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. A measure of shyness was used (Asendorpf, 1987), as was a measure of self-perceived attractiveness (Landolt, Lalumiere, & Quinsey, 1995). Finally sociosexual orientation was added to the analysis, which is a measure of sexual openness

and interest in short-term relationships (Penke & Asendorpf, 2008; Simpson & Gangestad, 1991).

Network Measures

Several types of centrality were calculated to understand each actor's role and position in the network at large. Each session represents its own network, as the only possible connections are between daters in the same session. Furthermore, in this directed data, men can only make offers to women, and women can only make offers to men, so all ties are always between opposite sex pairs. This dataset does not include any homosexual relations or friendship ties, it is only heterosexual mate choice offers.

The first measure of network centrality that was calculated was in-degree centrality, or the number of offers an individual received. This was normalized by the number of opposite sex daters in their session, as different sessions had varying numbers of daters. This measure provides a rough estimate of raw popularity – how many offers one receives from all possible suitors.

In addition to degree centrality, two versions of directed eigenvector centrality were calculated. Eigenvector centrality is a measure of prestige, or how many offers an individual receives from others who also receive a lot of offers. If there is a hierarchy in the daters, whereas high value mates are receiving offers from mid value mates who are receiving offers from low value mates (and low value mates are not receiving offers from mid or high level individuals) than this measure will uncover it. High variance among the eigenvector centrality values of the daters would illustrate this point, whereas low variance would imply that all daters are receiving offers effectively randomly, from any

and all possible suitors. Eigenvector centrality was calculated using two different sets of offers: The actual offers made and received amongst the daters, as well as the *perception* of offers received. This allows a comparison between the differences in actual prestige and popularity and the perception of one's social importance / mate value.

Results

The first analysis was to look at the distribution of centrality scores, to see if there were dramatic differences between the daters. If all daters were receiving the same number of offers, and had the same network prestige, it would be fruitless to look at their actor attributes. Figure 8-1 shows the frequency of actor in-degree centrality (normalized) for both men and women. A score of 1 implies that every dater in the session made an offer to the target individual.

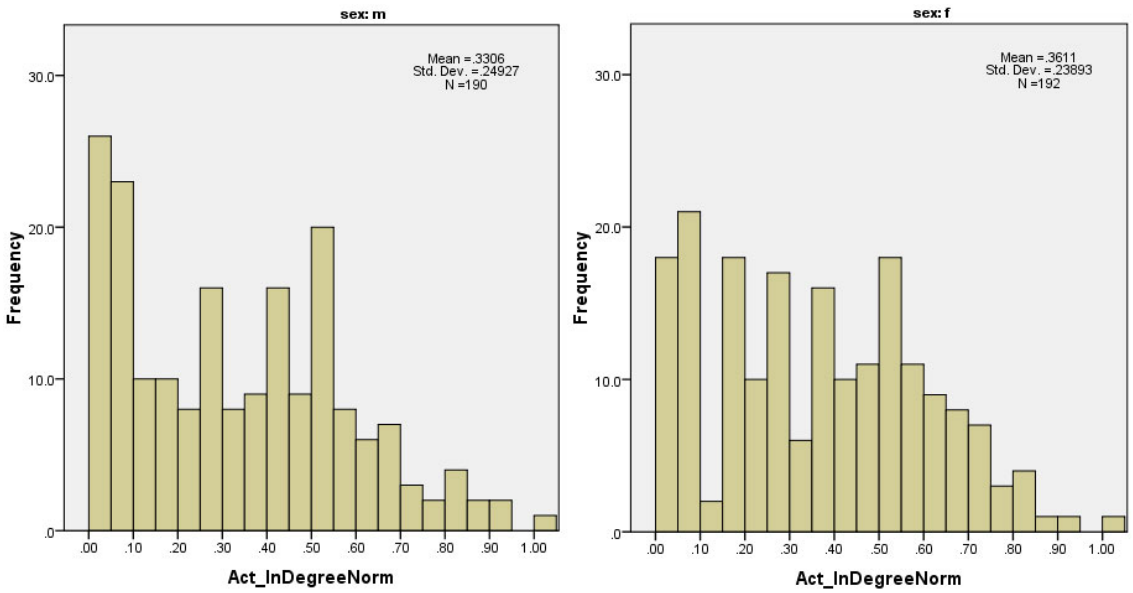

Figure 8-1: Frequency of in-degree centrality scores for all daters, presented separately for men and women.

Figure 8-2 presents results in the same fashion, but for actual eigenvector centrality – based on the offers made by the daters.

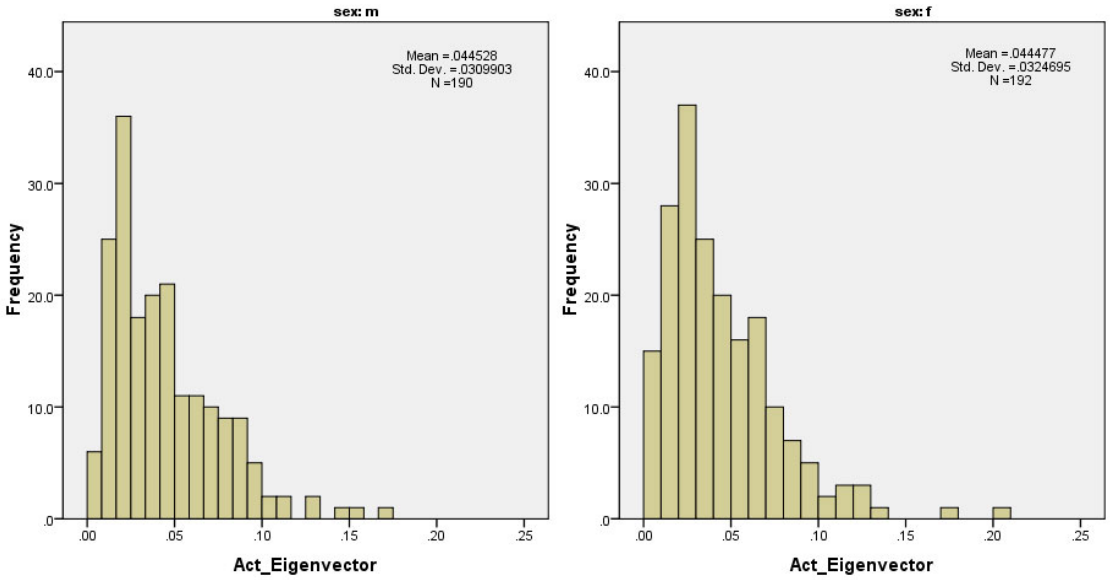

Figure 8-2: Frequency of actual directed eigenvector centrality scores for all daters, presented separately for men and women.

Figure 8-3 presents the results for perceived eigenvector centrality, based on the perception of offers received. Note that Figure 8-3 is presented with the same range of values as Figure 8-2.

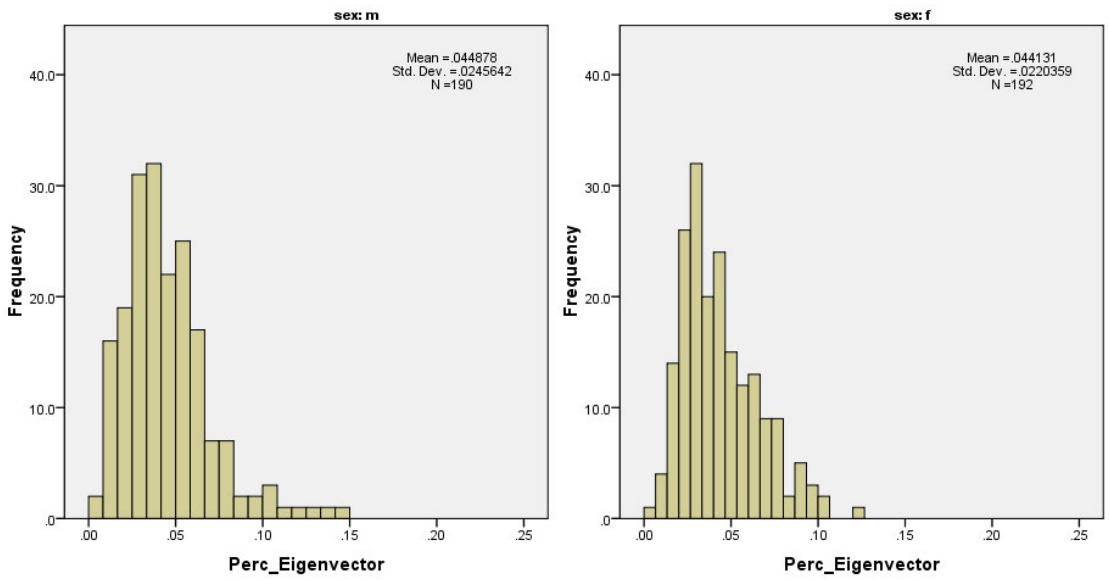

Figure 8-3: Frequency of perceived directed eigenvector centrality scores for all daters, presented separately for men and women.

The frequency of centrality scores clearly shows a variety in the scores of individual daters. This allows us to now use regression analysis to see if particular actor attributes are predicting different centrality scores.

The set of actor attributes (see Methods) were used in a linear regression analysis for each of the three dependent centrality measures, calculated separately for men and women. For in-degree centrality, for female daters, there was a significant effect amongst the actor attributes to explain the dependent effect, $F(12,191)=3.375$, $p=.000$. The variables that showed significance were age, $\beta=-.308$, $p=.001$, and attractiveness, $\beta=.228$, $p=.05$. This analysis shows that younger, more attractive women were receiving more offers on average. For male in-degree centrality, there were also significant findings, $F(12,188)=5.11$, $p=.000$. The significant variables were total time spent in serious

relationships, β=.236, p=.006, and attractiveness, β=.284, p=.001. Education level was trendy, β=.127, p=.076. Similar to the women, more attractive men led to more offers received, as did relationship experience and greater education.

For actual eigenvector centrality, difference started to emerge between the male and female daters. Female daters showed no significant regression results, $F(12,191)=1.59$, p=.095. For male daters, there was a significant overall effect, $F(12,188)= 4.42$, p=.000 with age β=-.171, p=.043, total number of relationships β=.186, p=.033, number of sex partners β=.182, p=.03 and attractiveness β=.257, p=.004 predicting actual eigenvector centrality. For predicting perceived eigenvector centrality, none of the variance could be explained by the variables, as neither regression analysis was significant for men or women.

Furthermore, one's actual eigenvector centrality could be correlated to one's perceived eigenvector centrality, to see if individuals were self-aware of their positioning, independent of the attributes that could be driving their network position. For women, there were no significant correlations between the two, r=.112, p=.122. For men, there was a weak significant correlation, r=.159, p<.028.

These effects can be demonstrated visually, by a series of figures that present these hierarchical mate value differences within one session. In Figure 8-4, nodes have been arranged vertically by actual eigenvector centrality for session 1208, a group of daters in their 20's. All ties are directed, and represent an actual offer made (arrows point towards the individual that received the offer). The node size represents actual eigenvector centrality, and node color is gender (red for women, blue for men). Arranged in this fashion, the hierarchical effects are quite clear, with the large nodes towards the

top of the Figure clearly receiving not only more offers, but offers from other larger nodes with high centrality values. The small nodes at the bottom of the figure are making a lot of offers, but receiving very few, and the offers they are receiving come from other low centrality nodes.

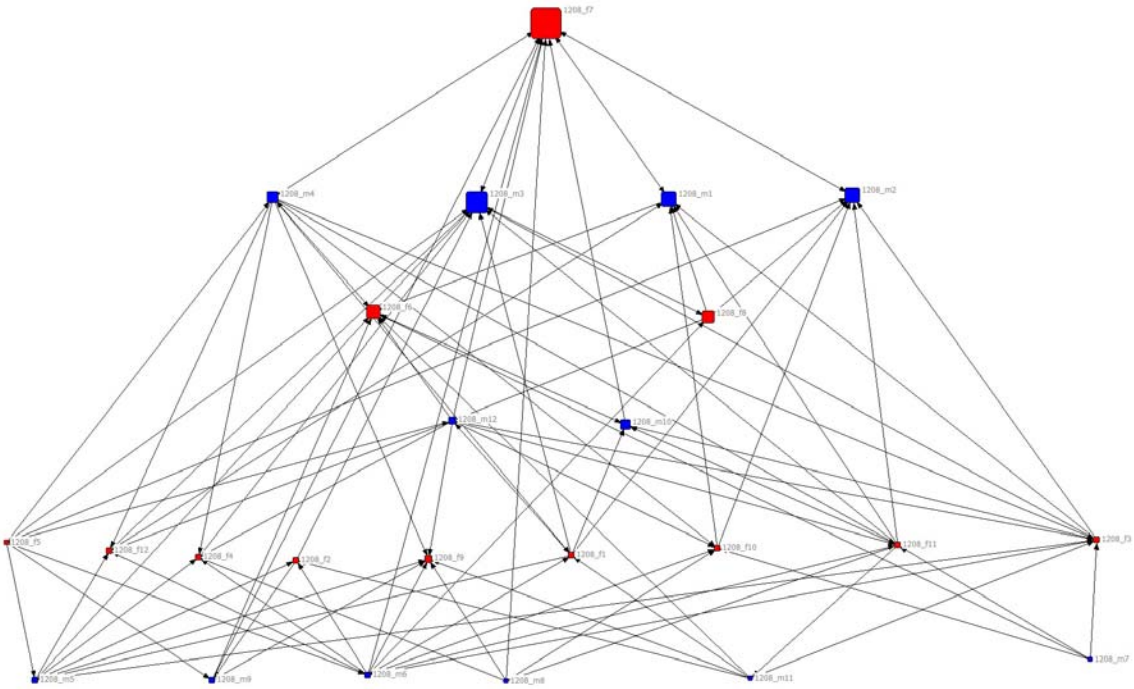

Figure 8-4: Directed actual offer ties made by speed-daters from one session. Graph is manually arranged to represent the hierarchy of actual eigenvector centrality, which is also represented by node size. Node color represents gender, with men as blue squares and women as red squares.

Eigenvector centrality can also be contrasted with in-degree centrality, to show the relationship between receiving many offers and having high network prestige. Figure 8-5 has the same nodes in the same hierarchal position, thus preserving their eigenvector centrality, while using the size of the node to represent in-degree centrality. It is clear that

while receiving more offers does assist in retaining a high prestige value, it is much more important from whom those offers come from. For example, in comparing nodes 1208_F06 and 1208_F08 (the two red nodes in the third tier from the top), while F06 is receiving many more offers, F08 is receiving more offers from men in the tier above her, thus equating the same eigenvector centrality.

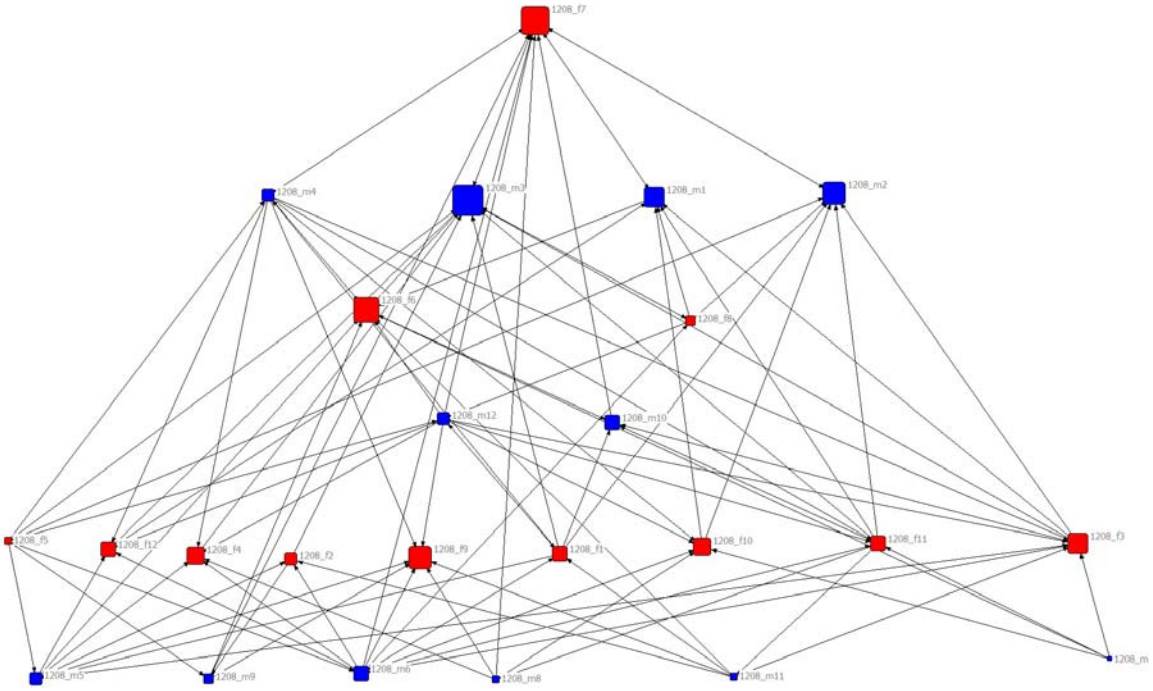

Figure 8-5: Directed actual offer ties made by speed-daters from one session. Graph is manually arranged to represent the hierarchy of actual eigenvector centrality (see Figure 8-4). Node size represents normed in-degree centrality. Node color represents gender, with men as blue squares and women as red squares.

Figures 8-4 and 8-5 present network graphs based on the actual offers, and actual eigenvector centrality present in the offers made and received by the speed-daters. However it is also possible to present similar diagrams with the perception of offers, and perception of prestige amongst the daters. One surprisingly result in this dataset is the lack of similarity between the actual eigenvector centrality and the perceived eigenvector centrality, as demonstrated in Figure 8-6. The individuals who are placed towards the top of the graph, representing their actual eigenvector centralities, do not necessary believe that they are the most central. In addition, there are nodes towards the bottom of the graph, particularly men, who believe many women are making offers towards them when in fact they are receiving very few. It is interesting that misperceptions of prestige happen at both ends of the spectrum, from individuals with high actual prestige (f7) believing they are more towards the mean, and individuals with low actual prestige (m9, m11) regresses up towards the mean.

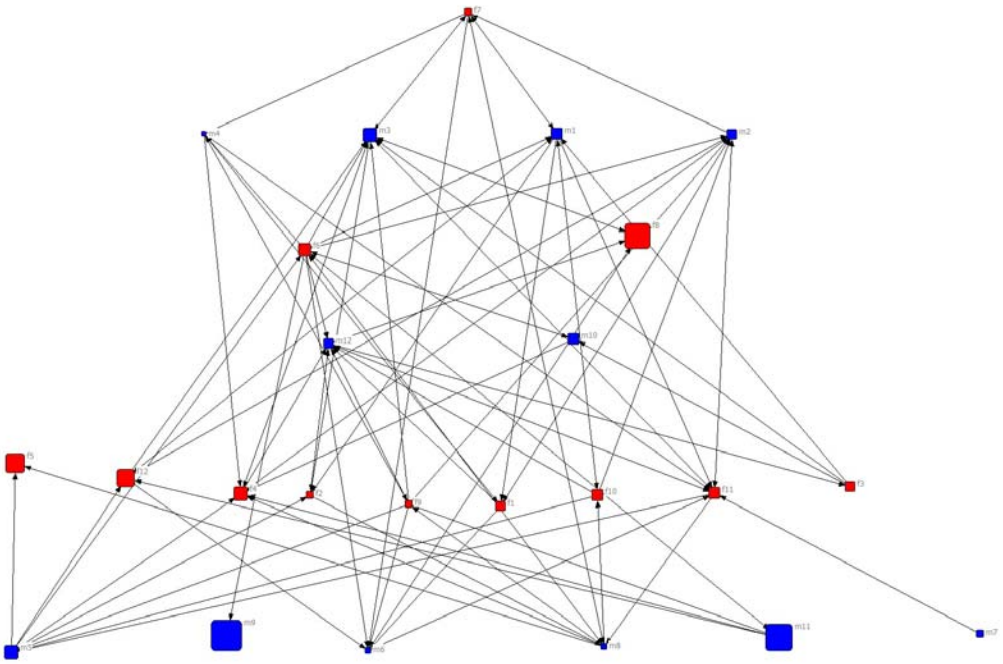

Figure 8-6: Directed perceived offer ties made by speed-daters from one session. These perceptions appear in the opposite direction as actual offers, such that an arrow pointed towards a node means that person believes to have received an offer from the source of that tie. Graph is manually arranged to represent the hierarchy of actual eigenvector centrality (see Figure 8-4). Node size represents perceived eigenvector centrality. Node color represents gender, with men as blue squares and women as red squares.

Discussion

Typical measures of mate choice success, in particular within speed-dating, measure the number of offers an individual receives (Finkel & Eastwick, 2009; Kurzban & Weeden, 2005). The baseline measure of in-degree centrality is such a measure, and the number of offers an individual receives is influenced by individual attributes that are typically associated with mate choice. Beauty and youth shape men's preference for women (and therefore the number of offers a women receives) while attractiveness, education and relationship experience help explain women's preferences. These patterns mimic previous findings (Buss, 1989).

However when stepping away from a simple measure of offer rates, and instead focusing on who the offers are coming from, a remarkably different pattern of results is found. For starters, there are in fact hierarchies present in speed-dating sessions, such that some individuals are receiving not only more offers, but offers from the individuals that everyone else is interested in. This shows not only the non-randomness of speed-dating offers, but that even within a controlled environment, where individuals are forced to interact with every other potential suitor, differences in popularity can arise. These differences in prestige show that further research is needed to study how different forms of popularity are affecting non-independent mate choice decisions. Furthermore, the eigenvector centrality is not predicted by the same actor attributes as in-degree centrality, begging the question of what makes someone prestigious as compared to popular. For men, some of the same attributes proved significant, but for women there were none. Surprisingly, attractiveness is not driving these placements, and perhaps other attributes

that were not tested in this study should be looked at more closely for their role in network importance within mate choice.

While previous research has shown that individuals have a fairly good sense of their own attractiveness, when it comes to their own network centrality, the data is a wash. Perceived prestige placements in the network had almost no correlation to actual network placements. Much of this could be due to self-fulfilling biases in the prediction of interest. If a dater is actually interested in their partner, they are much more likely to believe that they are liked in return, a bias that makes you believe the people you like are interested in return (Asendorpf, et al., in press). This is clearly not the case, as the actual eigenvector data shows: There are many individuals who receive offers from daters on a lower tier that are not reciprocated. It appears as if some individuals are living in an ideal world, where interest is always mutual, when in fact mutual offers only occur roughly 15% of the time. These biases do not seem to be plaguing any one type of dater more than the other, as no actor attributes correlated with perceived prestige. Independent of attractiveness, education or age, daters were placing themselves either central to the dating network or on its periphery.

While speed-dating data is a great start to look at network effects in mate choice, it does have its drawbacks. Most notable is the fixed age brackets: 20-30 year olds were only ever interacting with others in the same age range, which is not particularly realistic. It would far more interesting to look at offer rates and prestige centrality from datasets that had interactions between individuals of all ages. Network data from a source such as online dating would allow for the communication between individuals of all ages (among all other actor attributes that vary already). When anyone can be contacted by anyone

else, it would be interesting to see how clearly visible attributes such as attractiveness play a larger role not only in offer rates, but in eigenvector centrality.

Overall, using network tools to analyze the structure of mate choice environments provides insight into these romantic interactions that typical behavioral work might over look. Advanced centrality measures allow us to delve into the structure of the environment and to learn more about the characteristics of individuals that influence their network placement.

References

Andersson, M. B., & Iwasa, Y. (1996). Sexual selection. *Trends in Ecology & Evolution, 11*(2), 53-58.

Asendorpf, J. B. (1987). Videotape reconstruction of emotions and cognitions related to shyness. *Journal of Personality and Social Psychology, 53*(3), 542-549.

Asendorpf, J. B., Penke, L., & Back, M. (in press). From dating to mating and relating: Predictors of initial and long-term outcomes of speed-dating in a community sample. *European Journal of Personality*.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*, 1-49.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Finkel, E. J., & Eastwick, P. W. (2008). Speed-dating. *Current Directions in Psychological Science, 17*(3), 193-197.

Finkel, E. J., & Eastwick, P. W. (2009). Arbitrary Social Norms Influence Sex Differences in Romantic Selectivity. *Psychological Science, 20*(10), 1290-1295.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Galef, B. G. (2008). Social influences on the mate choices of male and female japanese quail. *Comparative Cognition & Behavior Reviews, 3*, 1-12.

Galef, B. G., & White, D. J. (1998). Mate-choice copying in Japanese quail,Coturnix coturnix japonica. *Animal Behaviour, 55*(3), 545-552.

Hill, S. E., & Ryan, M. (2006). The role of model female quality in the mate choice copying behaviour of sailfin mollies. *Biology Letters, 2*(2), 203-205.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Kirkpatrick, M., & Dugatkin, L. A. (1994). Sexual selection and the evolutionary effects of copying mate choice. *Behavioral Ecology and Sociobiology, 34*, 443-449.

Kondrashov, A. S. (1988). Deleterious mutations as an evolutionary factor. III. Mating preference and some general remarks. *Journal of Theoretical Biology, 131*(4), 487-496.

Kurzban, R., & Weeden, J. (2005). HurryDate: Mate preferences in action. *Evolution and Human Behavior, 26*(3), 227-244.

Landolt, M. A., Lalumiere, M. L., & Quinsey, V. L. (1995). Sex differences in intra-sex variations in human mating tactics: An evolutionary approach. *Ethology and Sociobiology, 16*(1), 3-23.

Little, A., Burriss, R. P., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2008). Social influence in human face preference: men and women are influenced more for long-term than short-term attractiveness decisions. *Evolution and Human Behavior, 29*(2), 140-146.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 1113-1135.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in press). Humans show mate copying after observing real mate choices. *Evolution and Human Behavior*.

Plath, M., Richter, S., Tiedemann, R., & Schlupp, I. (2008). Male Fish Deceive Competitors about Mating Preferences. *Current Biology, 18*(15), 1138-1141.

Pruett-Jones, S. (1992). Independent Versus Nonindependent Mate Choice: Do Females Copy Each Other? *The American Naturalist, 140*(6), 1000-1009.

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive Behavior, 10*(2), 113-136.

Simpson, J., & Gangestad, S. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology, 60*(6), 870-883.

Vakirtzis, A., & Roberts, S. (2009). Mate choice copying and mate quality bias: different processes, different species. *Behavioral Ecology, 20*(4), 908.

Witte, K., & Godin, J.-G. J. (2010). Mate choice copying and mate quality bias: are they different processes? *Behavioral Ecology, 21*(1), 193-194.

Conclusions

The results from the series of studies presented in this dissertation change and enhance our understanding of how humans utilize information to inform their mate choice decisions. It is now clear that social information coming from the local environment plays a major role in our selection of potential mates. Humans, like many other species living in social environments, utilize non-independent cues to augment their own perceptions and judgments of an individual's mate value.

Section one documents an adaptive mate choice mechanism for judging the romantic interest of others, a key cognitive component for utilizing social information during mate choice. These judgments can be made quickly and with limited information, and appear to utilize a hierarchy of cues that strongly favor global body motion when it is available. These cues can be recognized by individuals from many different cultures, as Americans, Chinese, and Germans can all accurately decipher non-verbal signals coming from German speed-daters. Male and female observers also appear to be using similar strategies to make these assessments, as they have evolved mechanisms that benefit the accurate understanding of both same-sex and opposite-sex romantic interest. Biases that play into the assessment of friendly behavior as potentially sexual, and gazing patterns that appear self-serving under non-directed tasks fade away when faced with the adaptive and goal oriented task of predicting the romantic interest between others. Men and women alike have evolved a mechanism that allows for the rapid and accurate assessment of romantic interest from cues that can be deciphered cross-culturally, and from limited information displays.

This ability is put to work when individuals are placed in a social environment, and these judgments lead to a dramatic change in one's mate choice preferences. With knowledge about the interest present amongst one's peers, section two shows us how this information alters one's interest in potential mates, based on who and how others are interested. Social information exerts its influence independent of age, sex or culture; however, individuals with different mate choice goals, personality profiles, and sexual histories use this information in different ways. The thrill seeker looking for a short-term fling might relish the chance to steal away a mate that others are actively seeking, while the risk-averse sexually inexperienced monogamist might monitor the choices of others in the hopes of finding a future partner who has similar attributes. Furthermore, the inherent differences in the validity and quality of mate choice displays between men and women alter the trust observers put in their observations. For female observers, perhaps knowledgeable that their same-sex peers tend to be coy and devious in their presentations of romantic interest, tend to only copy their peers' selections when the observers have additional information about the target, whose feedback and signals are easy to decipher than the women's herself. Clearly social information is not copied and utilized blindly, and different individuals observing differing signals and information sources only copy the selections of others when it is to their definite benefit.

While behavioral data on triadic interactions can go a long way in understanding the use of social information during mate choice, studying complex larger network interactions can provide a more realistic look into how phenomena might exist in real world settings. Section three demonstrates how differences in popularity and individual attributes could potentially influence non-independent mate choice selections. While

individuals who are receiving the most number of offers possess attributes in line with traditionally sexually selected attributes, individuals who are the most prestigious, and receive offers from other high-status individuals do not necessarily posses these same qualities. Network popularity, depending on its definition, is therefore an area of concern for how it might affect non-independent mate choice, and furthermore sexual selection.

Overall this body of work provides a major push forward in our understanding of the complex interactions and judgments surrounding mate choice in humans. When faced with the crucial task of picking a mate, and eventually a life partner, humans utilize information from a variety of sources to reach as optimal a decision as possible. Non-independent sources augment information that is gathered directly, and we have evolved adaptive mechanisms that allow us to survive and excel in our complex social world.

All References Cited:

Abbey, A. (1982). Sex differences in attributions for friendly behavior: Do males misperceive females' friendliness? *Journal of Personality and Social Psychology, 42*(5), 830-838.

Abbey, A., & Melby, C. (1986). The Effects of Nonverbal Cues on Gender Differences in Perceptions of Sexual Intent. *Sex Roles, 15*(5), 283.

Albright, L., Malloy, T., Dong, Q., Kenny, D., Fang, X., Winquist, L., et al. (1997). Cross-cultural consensus in personality judgments. *Journal of Personality and Social Psychology, 72*, 558-569.

Allen, E., & Baucom, D. (2004). Adult Attachment and Patterns of Extradyadic Involvement. *Family Process, 43*(4), 467-488.

Allen, E., & Baucom, D. (2006). Dating, Marital, and Hypothetical Extradyadic Involvements: How Do They Compare? *Journal of Sex Research, 43*(4), 307.

Alonzo, S. H. (2008). Female mate choice copying affects sexual selection in wild populations of the ocellated wrasse. *Animal Behaviour, 75*(5), 1715-1723.

Ambady, N., & Rosenthal, R. (1992). Thin slices of expressive behavior as predictors of interpersonal consequences: A meta-analysis. *Psychological Bulletin, 111*(2), 256-274.

Andersson, M. B. (1994). *Sexual Selection*. Princeton: Princeton University Press.

Andersson, M. B., & Iwasa, Y. (1996). Sexual selection. *Trends in Ecology & Evolution, 11*(2), 53-58.

Asendorpf, J. B. (1987). Videotape reconstruction of emotions and cognitions related to shyness. *Journal of Personality and Social Psychology, 53*(3), 542-549.

Asendorpf, J. B., Penke, L., & Back, M. (in press). From dating to mating and relating: Predictors of initial and long-term outcomes of speed-dating in a community sample. *European Journal of Personality*.

Berry, D., Kean, K., Misovich, S., & Baron, R. (1991). Quantized displays of human movement: A methodological alternative to the point-light display. *Journal of Nonverbal Behavior, 15*(2), 81-97.

Biesanz, J., West, S., & Millevoi, A. (2007). What do you learn about someone over time? The relationship between length of acquaintance and consensus and self-other agreement in judgments of personality. *Journal of Personality and Social Psychology, 92*(1), 119.

Borkenau, P., Mauer, N., Riemann, R., Spinath, F., & Angleitner, A. (2004). Thin slices of behavior as cues of personality and intelligence. *Journal of Personality and Social Psychology, 86*, 599-614.

Broude, G. (1983). Male-female relationships in cross-cultural perspective: A study of sex and intimacy. *Cross-Cultural Research, 18*(2), 154.

Brooks, R. (1998). The importance of mate copying and cultural inheritance of mating preferences. *Trends in Ecology & Evolution, 13*(2), 45-46.

Brown, G. R., & Fawcett, T. W. (2005). Sexual selection: copycat mating in birds. *Current Biology, 15*(16), R626-R628.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*, 1-49.

Buss, D. M. (2006). Strategies of Human Mating. *Psychological Topics, 15*(2), 239-260.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204-232.

Candolin, U. (2003). The use of multiple cues in mate choice. *Biological Reviews, 78*(4), 575-595.

Carney, D. R., Colvin, C. R., & Hall, J. A. (2007). A thin slice perspective on the accuracy of first impressions. *Journal of Research in Personality, 41*(5), 1054-1072.

Danchin, E., Giraldeau, L.-A., Valone, T. J., & Wagner, R. H. (2004). Public Information: From Nosy Neighbors to Cultural Evolution. *Science, 305*(5683), 487-491.

Darwin, C. (1859). *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*: Signet Classic.

Darwin, C. (1871). *The descent of man and selection in relation to sex.*

Doucet, S. M., Yezerinac, S. M., & Montgomerie, R. (2004). Do female zebra finches (Taeniopygia guttata) copy each others mate preferences? *Canadian Journal of Zoology, 82*, 1-7.

Dubois, F. (2007). Mate choice copying in monogamous species: should females use public information to choose extrapair mates? *Animal Behaviour, 74*(6), 1785-1793.

Dugatkin, L. A. (1992). Sexual selection and imitation - females copy the mate choice of others. *American Naturalist, 139*(6), 1384-1389.

Dugatkin, L. A. (2000). *The imitation factor : Evolution beyond the gene*. New York: Free Press.

Dugatkin, L. A., & Godin, J.-G. J. (1992). Reversal of Female Mate Choice by Copying in the Guppy (Poecilia reticulata). *Proceedings: Biological Sciences, 249*(1325), 179-184.

Dugatkin, L. A., & Godin, J.-G. J. (1993). Female mate copying in the guppy (Poecilia reticulata): age-dependent effects. *Behavioral Ecology, 4*(4), 289-292.

Eastwick, P. W., & Finkel, E. J. (2008). Sex differences in mate preferences revisited: Do people know what they initially desire in a romantic partner? *Journal of Personality and Social Psychology, 94*(2), 245-264.

Eva, K. W., & Wood, T. J. (2006). Are all the taken men good? An indirect examination of mate-choice copying in humans. *Canadian Medical Association Journal, 175*(12), 1573-1574.

Ekman, P., Friesen, W., O'Sullivan, M., Chan, A., Diacoyanni-Tarlatzis, I., Heider, K., et al. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *Journal of Personality and Social Psychology, 53*(4), 712-717.

Farris, C., Treat, T., Viken, R., & McFall, R. (2008). Sexual coercion and the misperception of sexual intent. *Clinical Psychology Review, 28*(1), 48-66.

Farris, C., Viken, R., Treat, T., & McFall, R. (2006). Heterosocial Perceptual Organization: Application of the Choice Model to Sexual Coercion. *Psychological Science, 17*(10), 869-875.

Farris, C., Treat, T., Viken, R., & McFall, R. (2008). Sexual coercion and the misperception of sexual intent. *Clinical Psychology Review, 28*(1), 48-66.

Finkel, E. J., & Eastwick, P. W. (2008). Speed-dating. *Current Directions in Psychological Science, 17*(3), 193-197.

Finkel, E. J., Eastwick, P. W., & Matthews, J. (2007). Speed-dating as an invaluable tool for studying romantic attraction: A methodological primer. *Personal Relationships, 14*(1), 149-166.

Freed-Brown, G., & White, D. J. (2009). Acoustic mate copying: female cowbirds attend to other females' vocalizations to modify their song preferences. *Proceedings of the Royal Society B: Biological Sciences, 276*(1671), 3319-3325.

Frommen, J., Rahn, A., Schroth, S., Waltschyk, N., & Bakker, T. (2008). Mate-choice copying when both sexes face high costs of reproduction. *Evolutionary Ecology*.

Funder, D. C. (2001). Accuracy in personality judgment: Some research and theory concerning an obvious question. In B. Roberts & R. Hogan (Eds.), *Personality psychology in the workplace* (pp. 121-140). Washington, DC: American Psychological Association.

Funder, D., & Colvin, C. (1988). Friends and strangers: Acquaintanceship, agreement, and the accuracy of personality judgment. *Journal of Personality and Social Psychology, 55*(1), 149-158.

Galef, B. G. (2008). Social influences on the mate choices of male and female japanese quail. *Comparative Cognition & Behavior Reviews, 3*, 1-12.

Galef, B. G., & White, D. J. (1998). Mate-choice copying in Japanese quail,Coturnix coturnix japonica. *Animal Behaviour, 55*(3), 545-552.

Gangestad, S., & Snyder, M. (1985). To carve nature at its joints": On the existence of discrete classes in personality. *Psychological Review, 92*(3), 317-349.

Gibson, R. M., & Höglund, J. (1992). Copying and sexual selection. *Trends in Ecology & Evolution, 7*(7), 229-232.

Godin, J.-G. J., Herdman, E. J. E., & Dugatkin, L. A. (2005). Social influences on female mate choice in the guppy, Poecilia reticulata: generalized and repeatable trait-copying behaviour. *Animal Behaviour, 69*(4), 999-1005.

Grammer, K. (1990). Strangers meet: Laughter and nonverbal signs of interest in opposite-sex encounters. *Journal of Nonverbal Behavior, 14*(4), 209-236.

Grammer, K., Honda, M., Juette, A., & Schmitt, A. (1999). Fuzziness of nonverbal courtship communication unblurred by motion energy detection. *Journal of Personality and Social Psychology, 77*(3), 487-508.

Grammer, K., Kruck, K., Juette, A., & Fink, B. (2000). Non-verbal behavior as courtship signals: the role of control and choice in selecting partners. *Evolution and Human Behavior, 21*(6), 371-390.

Grammer, K., Kruck, K., & Magnusson, M. (1998). The Courtship Dance: Patterns of Nonverbal Synchronization in Opposite-Sex Encounters. *Journal of Nonverbal Behavior, V22*(1), 3-29.

Greiling, H., & Buss, D. M. (2000). Women's sexual strategies: the hidden dimension of extra-pair mating. *Personality and Individual Differences, 28*(5), 929-963.

Harmon, L. (1973). The recognition of faces. *Scientific American, 229*(5), 71.

Haselton, M. G., & Buss, D. M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology, 78*(1), 81-91.

Henrich, J., Heine, S., & Norenzayan, A. (in press). The weirdest people in the world? *Behavioral and Brain Sciences*.

Hewig, J., Trippe, R., Hecht, H., Straube, T., & Miltner, W. (2008). Gender Differences for Specific Body Regions When Looking at Men and Women. *Journal of Nonverbal Behavior, 32*(2), 67-78.

Hill, S. E., & Buss, D. M. (2008). The mere presence of opposite-sex others on judgments of sexual and romantic desirability: opposite effects for men and women. *Personality & Social Psychology Bulletin, 34*(5), 635-647.

Hill, S. E., & Ryan, M. (2006). The role of model female quality in the mate choice copying behaviour of sailfin mollies. *Biology Letters, 2*(2), 203-205.

Johansson, G. (1973). Visual perception of biological motion and a model for its analysis. *Perceiving events and objects*.

Jones, B., DeBruine, L., Little, A., Burriss, R., & Feinberg, D. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B: Biological Sciences, 274*(1611), 899-903.

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. In D. M. Buss (Ed.), *The Handbook of Evolutionary Psychology* (pp. 68-95). New York: Wiley.

Kenny, D. A. (1994). *Interpersonal perception: A social relations analysis*. New York: Guilford Press.

Kenny, D. A., & Albright, L. (1987). Accuracy in interpersonal perception: A social relations analysis. *Psychological Bulletin, 102*(3), 390-402.

Kenny, D. A., Bond, C. F., Jr., Mohr, C. D., & Horn, E. M. (1996). Do we know how much people like one another? *Journal of Personality and Social Psychology, 71*(5), 928-936.

Kirkpatrick, M. (1982). Sexual selection and the evolution of female choice. *Evolution, 36*(1), 1-12.

Kirkpatrick, M., & Dugatkin, L. A. (1994). Sexual selection and the evolutionary effects of copying mate choice. *Behavioral Ecology and Sociobiology, 34*, 443-449.

Kokko, H., Brooks, R., Jennions, M. D., & Morley, J. (2003). Review Paper. The Evolution of Mate Choice and Mating Biases. *Proceedings: Biological Sciences, 270*(1515), 653-664.

Kondrashov, A. S. (1988). Deleterious mutations as an evolutionary factor. III. Mating preference and some general remarks. *Journal of Theoretical Biology, 131*(4), 487-496.

Kozlowski, L., & Cutting, J. (1977). Recognizing the sex of a walker from a dynamic point-light display. *Perception & Psychophysics, 21*(6), 575-580.

Kraus, M., & Keltner, D. (2009). Signs of socioeconomic status: A thin-slicing approach. *Psychological Science, 20*(1), 99–106.

Kurzban, R., & Weeden, J. (2005). HurryDate: Mate preferences in action. *Evolution and Human Behavior, 26*(3), 227-244.

Landolt, M. A., Lalumiere, M. L., & Quinsey, V. L. (1995). Sex differences in intra-sex variations in human mating tactics: An evolutionary approach. *Ethology and Sociobiology, 16*(1), 3-23.

Lindgren, K., Parkhill, M., George, W., & Hendershot, C. (2008). Gender differences in perceptions of sexual intent: A qualitative review and integration. *Psychology of Women Quarterly, 32*(4), 423.

Little, A., Burriss, R. P., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2008). Social influence in human face preference: men and women are influenced more for long-term than short-term attractiveness decisions. *Evolution and Human Behavior, 29*(2), 140-146.

Long, J. M., Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in prep). Seeing is misperceiving: How different sources of information affect the perception of romantic interest.

McClure, E. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. *Psychological Bulletin, 126*(3), 424-453.

Moore, M. M. (1985). Nonverbal courtship patterns in women: Context and consequences. *Ethology and Sociobiology, 6*(4), 237–247.

Moore, M. M. (2002). Courtship communication and perception. *Percept Mot Skills, 94*(1), 97-105.

Moore, M. M., & Butler, D. L. (1989). Predictive aspects of nonverbal courtship behavior in women. *Semiotica, 76*(3/4), 205-215.

Morrone, M., Burr, D., & Ross, J. (1983). Added noise restores recognizability of coarse quantized images. *Nature, 305*(5931), 226-228.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 113-1135.

Penke, L., & Denissen, J. J. A. (2008). Sex differences and lifestyle-dependent shifts in the attunement of self-esteem to self-perceived mate value: Hints to an adaptive mechanism? *Journal of Research in Personality, 42*, 1123-1129.

Penke, L., Todd, P. M., Lenton, A. P., & Fasolo, B. (2007). How self-assessments can guide human mating decisions. In *Mating intelligence: Sex, relationships, and the mind's reproductive system* (pp. 37-75). Mahwah, NJ: Lawrence Erlbaum.

Pentland, A. (2007). On the collective nature of human intelligence. *Adaptive Behavior, 15*(2), 189-198.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (2009). The ability to judge the romantic interest of others. *Psychological Science, 20*(1), 22-26.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in prep). Changes in information quality and observer confidence affect social information usage during mate choice in humans.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in prep). Men and women attend to the same cues during judgments of romantic interest.

Place, S. S., Todd, P. M., Zhuang, J., Penke, L., & Asendorpf, J. B. (submitted). Judging romantic interest of others is a cross-cultural ability. *Psychological Science*.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in press). Humans show mate copying after observing real mate choices. *Evolution and Human Behavior*.

Plath, M., Richter, S., Tiedemann, R., & Schlupp, I. (2008). Male Fish Deceive Competitors about Mating Preferences. *Current Biology, 18*(15), 1138-1141.

Pruett-Jones, S. (1992). Independent Versus Nonindependent Mate Choice: Do Females Copy Each Other? *The American Naturalist, 140*(6), 1000-1009.

Renninger, L. A., Wade, T. J., & Grammer, K. (2004). Getting that female glance: Patterns and consequences of male nonverbal behavior in courtship contexts. *Evolution and Human Behavior, 25*(6), 416-431.

Ryan, M. J., Akre, K. L., & Kirkpatrick, M. (2007). Mate choice. *Current Biology, 17*(9), R313-R316.

Rupp, H., & Wallen, K. (2007). Sex differences in viewing sexual stimuli: An eye-tracking study in men and women. *Hormones and Behavior, 51*(4), 524-533.

Schmitt, D. P., Alcalay, L., Allensworth, M., Allik, J., Ault, L., Austers, I., et al. (2004). Patterns and Universals of Adult Romantic Attachment Across 62 Cultural Regions: Are Models of Self and of Other Pancultural Constructs? *Journal of Cross-Cultural Psychology, 35*(4), 367-402. doi: 10.1177/0022022104266105

Schmitt, D., & Buss, D. (2001). Human mate poaching: Tactics and temptations for infiltrating existing mateships. *Journal of Personality and Social Psychology, 80*(6), 894-917.

Seal, D., Agostinelli, G., & Hannett, C. (1994). Extradyadic romantic involvement: Moderating effects of sociosexuality and gender. *Sex Roles, 31*(1), 1-22.

Shackelford, T. K., & Goetz, A. T. (2007). Adaptation to Sperm Competition in Humans. *Current Directions in Psychological Science, 16*(1), 47-50.

Simão, J., & Todd, P. M. (2002). Modeling mate choice in monogamous mating systems with courtship. *Adaptive behavior, 10*(2), 113-136.

Simpson, J., & Gangestad, S. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology, 60*(6), 870-883.

Smith, E. R., & Collins, E. C. (2009). Contextualizing person perception: Distributed social cognition. *Psychological Review, 116*(2), 343-364.

Snyder, M. (1974). Self-monitoring of expressive behavior. *Journal of Personality and Social Psychology, 30*(4), 526-537.

Snyder, M., Simpson, J. A., & Gangestad, S. (1986). Personality and Sexual Relations. *Journal of Personality and Social Psychology, 51*(1), 181-190.

Swaddle, J. P., Cathey, M. G., Correll, M., & Hodkinson, B. P. (2005). Socially transmitted mate preferences in a monogamous bird: a non-genetic mechanism of sexual selection. *Proceedings of the Royal Society B: Biological Sciences, 272*(1567), 1053-1058.

Thayer, J., & Johnsen, B. (2000). Sex differences in judgement of facial affect: a multivariate analysis of recognition errors. *Scandinavian Journal of Psychology, 41*(3), 243-246.

Thornhill, R., & Grammer, K. (1999). The Body and Face of Woman One Ornament that Signals Quality? *Evolution and Human Behavior, 20*(2), 105-120.

Todd, P. M., & Miller, G. F. (1999). From pride and prejudice to persuasion: Realistic heuristics for mate search. In G. Gigerenzer, P. M. Todd & t. A. R. Group (Eds.), *Simple heuristics that make us smart*. New York: Oxford University Press.

Todd, P. M., Penke, L., Fasolo, B., & Lenton, A. P. (2007). Different cognitive processes underlie human mate choices and mate preferences. *Proceedings of the National Academy of Sciences, 104*(38), 15011-15016.

Tovée, M., Maisey, D., Emery, J., & Cornelissen, P. (1999). Visual cues to female physical attractiveness. *Proceedings of the Royal Society B: Biological Sciences, 266*(1415), 211.

Tovée, M., Reinhardt, S., Emery, J., & Cornelissen, P. (1998). Optimum body-mass index and maximum sexual attractiveness. *Lancet, 352*(9127), 548-548.

Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Chicago, IL: Aldine-Atherton.

Uller, T. (2003). Human mate choice and the wedding ring effect - Are married men more attractive? *Human Nature, 14*(3), 267-276.

Vakirtzis, A., & Roberts, S. (2009). Mate choice copying and mate quality bias: different processes, different species. *Behavioral Ecology, 20*(4), 908.

Vukomanovic, J., & Rodd, F. (2007). Size-Dependent Female Mate Copying in the Guppy (Poecilia reticulata): Large Females are Role Models but Small Ones are not. *Ethology, 113*(6), 579-586.

Waynforth, D. (2007). Mate choice copying in humans. *Human Nature, 18*(3), 264-271.

Westneat, D. F., Walters, A., McCarthy, T. M., Hatch, M. I., & Hein, W. K. (2000). Alternative mechanisms of nonindependent mate choice. *Animal Behaviour, 59*(3), 467-476.

White, D. J., & Galef, B. G. (1999). Mate choice copying and conspecific cueing in Japanese quail, Coturnix coturnix japonica. *Animal Behaviour, 57*, 465-473.

White, D. J., & Galef, B. G. (2000a). `Culture' in quail: social influences on mate choices of female Coturnix japonica. *Animal Behaviour, 59*(5), 975-979.

White, D. J., & Galef, B. G. (2000b). Differences between the sexes in direction and duration of response to seeing a potential sex partner mate with another. *Animal Behaviour, 59*(6), 1235-1240.

Whitfield, J. (2002). Nosy neighbours. *Nature, 419*(6904), 242-243.

Wiegmann, D. D., & Angeloni, L. M. (2007). Mate choice and uncertainty in the decision process. *Journal of Theoretical Biology*, *249*(4), 654-666.

Willis, J., & Todorov, A. (2006). First Impressions: Making Up Your Mind After a 100-Ms Exposure to a Face. *Psychological Science*, *17*(7), 592-598.

Witte, K., & Godin, J.-G. J. (in press). Mate choice copying and mate quality bias: are they different processes? *Behavioral Ecology*.

Yorzinski, J. L., & Platt, M. L. (2010). Same-Sex Gaze Attraction Influences Mate-Choice Copying in Humans. *PLoS ONE*, *5*(2), e9115.

Appendix A

Instructions for Experiments

All survey questions were verbatim from previously published sources.

Chapters 1 and 2:

You will be presented with a series of video clips. Each clip is a conversation between a man and a woman who are meeting each other for the first time. They are participants in a "Speed Dating" event, where each participant talks briefly with several members of the opposite sex in the hope of finding an interesting future partner. After each conversation, the man and woman both decide if they would want to see the other person again. Mutually interested couples receive each other's contact information, and are free to meet again.

Each video consists of footage combined from two camera angles. The man and woman are sitting across from each other, with the camera placed "over the shoulder" of each participant. In each clip, the man appears on the left side of the screen and the woman appears on the right. Remember that they are actually facing each other, and are not side by side.

Your task is to view each video, and decide if you think the participants are interested in each other and would want to see each other again. The participants are speaking in German, so you will have to use other information than vocal content to make your decisions. After each video clip, you will first be asked if the man is interested in the woman. Press Y for yes he is interested, or N for no he is not. You will then be asked the same question about the woman's interest in the man.

You may take short breaks whenever you would like, by leaving the experiment on a screen that tells you what trial number you are currently on.

Chapter 4:

Contained the same instructions as Chapters 1 and 2, with the addition of the following paragraph:

The video quality is degraded so that you can't make out the details of the people. They will appear as colorful blobs.

Chapters 5, 6 and 7

All of these experiments contained similar instructions for both the initial picture rating, as well as the video presentations.

Part 1 (pictures):

You will be presented with a series of pictures of individuals. For each picture, you will answer several questions concerning what you think about the person in the picture. Please answer each question accurately and honestly. Thank you.

Part 2 (video and pictures):

You will be presented with a series of video clips. Each clip is a conversation between a man and a woman who are meeting each other for the first time. They are participants in a real "Speed Dating" event, where each participant talks briefly with several members of the opposite sex one at a time in the hope of finding potential future partners. After each conversation, the man and woman both decide if they would want to see the other person again. Mutually interested couples receive each other's contact information, and are free to meet again.

Your task is to decide if you think the man is interested in the woman, and if the woman is likewise interested in the man.

Appendix B

Experimental Software

Chapters 1, 2 and 4 were run using the DirectRT software package (version 2004.3) from Empirisoft (http://www.empirisoft.com/). This software package uses excel type spreadsheets as input and allows presentation of both picture and video. The IU Psychology department holds a license for this software. This software platform is easy to use and is quite modular, however it stores all of the experimental data locally, and requires the software platform to be installed on every testing computer. This makes it an inadequate platform for internet based studies.

Chapter 3 was run using SR Research's Experiment Builder software (http://www.sr-research.com/), which is a proprietary package that is required by their eye tracking hardware. This software package is a visual programming suite, with an event based paradigm. It also allows plugins of pure python code.

The remaining experiments were programming in a custom built web-based database-driven Flash environment. The front end was a Flash 9 and 10 presentation using action script 3 programmed in Adobe Flash CS3. This allows for dynamic text (instructions by condition) as well as picture and video displays. Stimuli were inputted via XML formatted stimuli sheets, allowing for dynamic stimuli selection, and an ability to update stimuli independently from experimental design. The data was stored in a MYSQL server

as a part of the IU webserve system. Data was moved from Flash to the database using PHP pages. This allowed a modular clean experimental design, that was able to be run with ease either in lab or on the web (all experiments were served via websites). Experiments were stored on the IU webserve system, and data was moved to the database via secure SSL encryption. Because all data was stored locally on secure IU servers, collaborators had no way of directly accessing the datastream, allowing for guaranteed unaltered results.

Example XML input:

```
<order>

<item id='1'>
    <Name>http://www.indiana.edu/~abcwest/flash/MC1/movies/double/0209_f01_m08
    _zweibild_10M.flv</Name>
     <MtoW>1</MtoW>
     <WtoM>0</WtoM>
</item>

<item id='2'>
    <Name>http://www.indiana.edu/~abcwest/flash/MC1/movies/double/0209_f02_m07
    _zweibild_10M.flv</Name>
    <MtoW>0</MtoW>
    <WtoM>0</WtoM>
</item>

<item id='3'>
    <Name>http://www.indiana.edu/~abcwest/flash/MC1/movies/double/0209_f04_m09
    _zweibild_10M.flv</Name>
    <MtoW>0</MtoW>
    <WtoM>0</WtoM>
</item>

<item id='4'>
    <Name>http://www.indiana.edu/~abcwest/flash/MC1/movies/double/0209_f06_m04
    _zweibild_10M.flv</Name>
```

```
    <MtoW>0</MtoW>
    <WtoM>0</WtoM>
</item>

</order>
```

Example PHP database call:

```
#!/usr/local/bin/php

<?php

//connect to the database server
$link = mysql_connect("mysql.iu.edu:3383", "USER", "PASSWORD")
   or die('Could not connect: ' . mysql_error());

//select database
mysql_select_db('data') or die('Could not select database');

//generate time
$format = '%H:%M:%S';
$strf = strftime($format);

//insert consent information
mysql_query("INSERT INTO MC_v1_R1
(subnum,gender,date,time,condition,STR1,LTR1,target,trial)
VALUES('".$_POST['subnum']."','".$_POST['gender']."','".date('Y-m-d')."',
'".$strf."','".$_POST['condition']."','".$_POST['STR1']."','".$_POST['LTR1']."','".$_POST
['target1']."','".$_POST['trial']."') ") or die(mysql_error());

echo "success!";

// close database
mysql_close($link);

?>
```

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EDUCATION

Max Planck Institute: International Research School on Adapting Behavior in a Fundamentally Uncertain World, Jena, Germany *(interdisciplinary group of psychologists, economists and legal scholars)*
May 2007–present — External Fellow

Indiana University, Bloomington, IN — Doctoral Candidate
Aug. 2006–present — Expected Degree: May 2010
Dual-Degree Ph.D. Program
Cognitive Psychology and Cognitive Science
Advisor: Peter Todd

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Dr. Robert Goldstone: Psychology, Cognitive Science
Dr. Eliot Smith: Psychology, Cognitive Science
Dr. Peter Todd: Psychology, Cognitive Science, Informatics
Dr. Stanley Wasserman: Psychology, Statistics, Sociology
Dr. Meredith West: Psychology, Biology

Colby College, Waterville, ME — B.A. received May 2004
Aug. 2000–May 2004
Major: Computer Science
Minor: Psychology

AWARDS

- **National Science Foundation "IGERT" Fellowship,** trainee in dynamics of brain-body-environment interaction in behavior and cognition, 2009-2010
- **Summer Fellowship,** Indiana University Center for the Integrated Study of Animal Behavior, 2009
- **Supplemental Research Fellowship**, Indiana University Cognitive Science Program, 2009
- **Best Student Poster**, Consortium for Computing Sciences in Colleges, 2004
  "Visual expectations: a cognitive model of fuzzy decision."
- **Best Student Poster**, Consortium for Computing Sciences in Colleges, 2003
  "From genes to queens: a 'crafty' approach to genetically evolve a chess engine."

TEACHING EXPERIENCE

Dept. of Psychological and Brain Sciences, Indiana University — Fall 2006–present
Associate Instructor

- Helped struggling students; gave guest lectures; graded course material
  - Introduction to Psychology (P101), Fall 2006, Fall 2007, Spring 2008
  - Psychology of Personality (P319), Fall 2006
  - Infant Development Seminar (P457), Spring 2007
  - Organizational and Industrial Psychology (P323), Spring 2007
  - Cognitive Psychology (P335), Summer 2007, Fall 2008, Fall 2009
  - Sensation and Perception (P329), Fall 2008
  - Human Memory (P340), Spring 2009

Dept. of Brain and Cognitive Science, Massachusetts Institute of Technology — 2005–2006
Teaching Assistant

- Led recitation sections weekly; prepared and presented course material
- Helped professor develop testing materials; graded all papers and exams
  - Introduction to Brain and Cognitive Sciences (9.00), Fall 2005 & Fall 2006

RESEARCH EXPERIENCE

Innovation & Social Information Lab, Dept of Biology, Utrecht University, Utrecht, Holland Summer 2009
Visiting Research Scientist

- Worked with Drs. Simon Reader and Ulf Toelch to develop a new research paradigm to study social information usage in humans.
- Designed, implemented and ran interactive group behavior experiments & simulations.

Visual Attention Lab, Brigham and Women's Hospital/Harvard Medical School 2004–2006
Research Assistant

- Worked with Drs. Jeremy Wolfe and Todd Horowitz to research the abilities of the visual system in a variety of visual tasks; research focused on visual search, multiple object tracking, and the Guided Search model
- Designed, implemented and ran a variety of psychophysical experiments
- Prepared manuscripts and presented results at conferences
- Assisted in lab managerial tasks; recruited subjects, ordered supplies, and maintained records

Dept. of Computer Science, Colby College 2003–2004
Research Assistant

- Worked with Dr. Clare Bates Congdon on bioinformatics research
- Completed literature reviews and summarized previous work

Independent Undergraduate Research Projects 2002–2004

- Senior thesis: "Visual expectations: Using machine learning to identify patterns in psychological data."
- "Information sharing in an artificial society."
- "From genes to queens: a 'crafty' approach to genetically modify a chess engine."

AD HOC REVIEWING

- *Adaptive Behavior, Journal of Experimental Social Psychology, Journal of Theoretical Biology, Social Psychological and Personality Science*

PROFESSIONAL SOCIETY MEMBERSHIPS

- *Assocation for Psychological Science (APS)*
- *Center for the Integrative Study of Animal Behavior at Indiana University (CISAB)*
- *Cognitive Science Society (CSS)*
- *Comparative Cognition Society (CCS)*
- *Human Behavior and Evolution Society (HBES)*
- *International Network for Social Network Analysis (INSNA)*

PUBLICATIONS

(Three first author publications are in preperation for submission)

Place, S. S., Todd, P. M., Zhuang, J., Penke, L., & Asendorpf, J. B. (under review). Judging romantic interest of others is a cross-cultural ability.

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J. B. (in press). Humans show mate copying after observing real mate choices. *Evolution and Human Behavior.*

Place, S. S., Todd, P. M., Penke, L., & Asendorpf, J.B. (2009). The ability to judge the romantic interest of others. *Psychological Science 20*(1), 22-26.

Wolfe, J. M., Horowitz, T. S., Van Wert, M. J., Kenner, N. M., **Place, S. S.**, & Kibbi, N. (2007). Low target prevalence is a stubborn source of errors in visual search tasks. *Journal of Experimental Psychology: General, 136*(4), 623-638.

Wolfe, J. M., **Place, S. S.**, & Horowitz, T. S. (2007). Multiple Object Juggling: Changing what is tracked during extended multiple object tracking. *Psych Bulletin & Review, 14*(2), 344-349.

Fencsik, D. E., Urrea, J., **Place, S. S.**, Wolfe, J. M., & Horowitz, T.S. (2006). Velocity cues improve visual search and multiple object tracking. *Visual Cognition*, 14, 92-95.

PRESS

My research on judging romantic interest has been covered in the national papers of Canada, Austria and Germany (Globe and Mail, Krone, Welt), the Chicago Tribune, National Public Radio, talk radio in Chicago and Los Angeles, as well as scientific magazines (Science News, Psychology Today, Bild der Wissenschaft (Germany), Tiede (Finland)), popular health & wellness press (Men's Health, Self, Women's Health, Fitforfun (Germany) and the online community (msnbc.com, sciencedaily.com, etc).

CONFERENCE PRESENTATIONS

Place, S.S. & Todd, P.M. (2010, May). *Judging romantic interest of others is a cross-cultural ability*. Poster presented at the Association for Psychological Science 22nd Annual Convention, Boston, MA.

Long, J.M., **Place, S.S.** & Todd, P.M. (2010, May). *Seeing Is miscperceiving: How different sources of information affect the perception of romantic interest*. Poster presented at the Association for Psychological Science 22nd Annual Convention, Boston, MA.

Place, S.S. & Todd, P.M. (2009, November). *Humans copy social information in mate choice decisions.* Poster presented at the 30th Annual Conference of the Society for Judgment and Decision Making, Boston, MA.

Place, S.S., Todd, P.M & Penke, L. (2009, November). *Humans show mate copying after observing real mate choices.* Talk presented at the Fall Meeting of the Comparative Cognition Society, Boston, MA.

Place, S.S. & Todd, P.M. (2009, July). *Decision making in mate choice: prospecting for potential mates.* Talk presented at the 31st Annual Conference of the Cognitive Science Society, Amsterdam, Holland.

Place, S.S. (2009, July). *Utilizing social information during mate choice.* Invited talk presented at Utrecht University, Utrecht, Holland.

Place, S.S., Todd, P.M. & Penke, L. (2009, May). *Humans show mate copying after observing real mate choices.* Talk presented at the 21th Annual Meeting of the Human Behavior and Evolution Society, Fullerton, CA.

Bowers, R.I., Todd, P.M., **Place, S.S.** & Penke, L. (2009, May). *Trait-based versus individual-based mate choice copying in humans*. Talk presented at the 21th Annual Meeting of the Human Behavior and Evolution Society, Fullerton, CA.

Place, S.S. & Todd, P.M. (2008, May). *Mate choice copying in humans observed during speed-dating*. Poster presented at the Association for Psychological Science 20th Annual Convention, Chicago, IL.

Place, S.S. & Todd, P.M. (2008, May). *Mate copying in humans*. Talk presented at the Center for the Integrated Study of Animal Behavior Annual Conference, Bloomington, IN.

Place, S.S. & Todd, P.M. (2008, April). *Studying mate search and choice with speed-dating.* Invited talk presented at Miami University, Oxford, OH.

Place, S.S. , Todd, P.M., Penke, L. & Asendorpf, J. (2007, June). *Observer ratings of human mating interactions.* Poster presented at the 19th Annual Meeting of the Human Behavior and Evolution Society, Williamsburg, VA.

Place, S.S. & Todd, P.M. (2007, May). *Mate copying in humans*. Talk presented at the Center for the Integrated Study of Animal Behavior Annual Conference, Bloomington, IN.

Van Wert, M. J., Horowitz, T. S., **Place, S. S.**, & Wolfe, J. M. (2006). Errors in low prevalence visual search: Easy to produce, hard to cure. *Journal of Vision*, *6*(6), 444a.

Place, S. S., & Horowitz, T. S. (2006). Which way did it go? Measuring trajectory information in multiple object tracking. *Journal of Vision*, *6*(6), 767a.

Fencsik, D. E., Horowitz, T. S., **Place, S. S.**, Klieger, S. B., & Wolfe, J. M. (2005). Target tracking during interruption in the multiple-object tracking task. *Journal of Vision*, **5**(8), 28.

Horowitz, T. S. & **Place, S. S.** (2005). How do distractors affect performance on the multiple object tracking task? *Abstracts of the Psychonomic Society*, **10**.

Horowitz, T. S. & **Place, S. S.** (2005). Picking up where you left off: The timecourse of target recovery after a gap in multiple object tracking. *Perception*, **35** (supplement).

Horowitz, T. S. & **Place, S. S.** (2005). Rapid recovery of targets in multiple object tracking. *Journal of Vision*, **5**(8), 29.

Place S.S. & Wolfe J.M. (2005). Multiple Visual Object Juggling. *Journal of Vision*, **5**(8), 27a.

Place, S.S. (2004). Visual expectations: a cognitive model of fuzzy decision making. *J. Comput. Small Coll.* 19, 5 (May. 2004), 310-310.

Attiyeh, M. and **Place, S.S.** (2003). From genes to queens: a "crafty" approach to genetically evolve a chess engine. *J. Comput. Small Coll.* 18, 5 (May. 2003), 248-249.